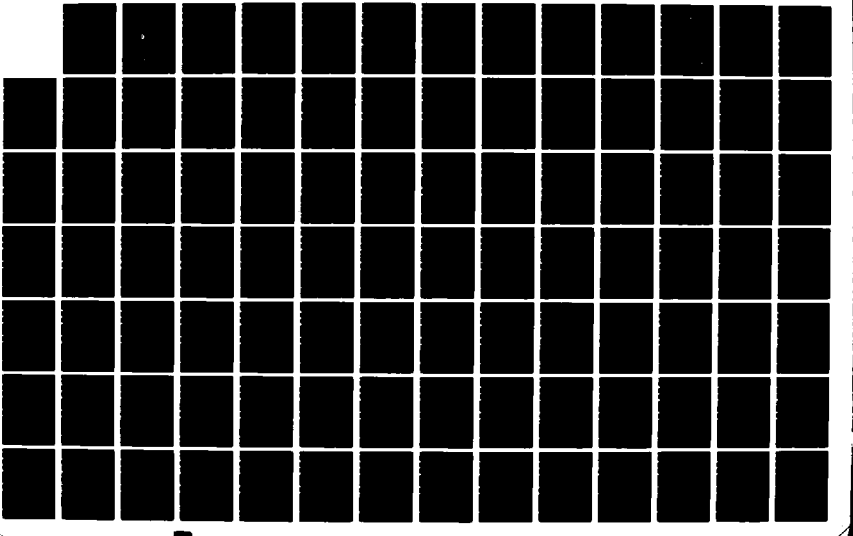

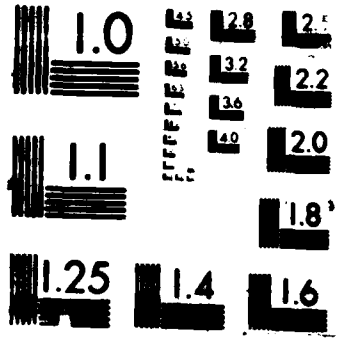
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DOT/FAA/CT-87/29

FAA Technical Center
Atlantic City International Airport
N.J. 08405

Software Conversion Study for the Maintenance Processing Subsystem Hardware Upgrade

Computer Technology Associates, Inc.

June 1987

Final Report

U.S. Department of Transportation
Federal Aviation Administration

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/CT-87/29	AD-A186247	

4. Title and Subtitle	5. Report Date
Software Conversion Study for the Maintenance Processing Subsystem Hardware Upgrade	June 1987
	6. Performing Organization Code: ACT-110
7. Author(s)	8. Performing Organization Report No.
Computer Technology Associates, Inc.	DOT/FAA/CT-87/29
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Computer Technology Associates, Inc. 5670 Greenwood Plaza Blvd., Suite 200 Englewood, CO 80111	11. Contract or Grant No. DTFA03-86-C-00018
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Department of Transportation Federal Aviation Administration Technical Center Atlantic City International Airport, NJ 08405	Final Report June 1987
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This software conversion study was made in support of the procurement of hardware upgrades to the 38 Maintenance Processing Subsystems (MPSs) which are the host computers for the Remote Maintenance Monitoring System (RMMS). Two major functions are provided by the RMMS: (1) Monitoring and Control via the Interim Monitoring and Control Software (IMCS) and (2) Management Information via the Maintenance Management System (MMS). This study analyzed the costs/benefits of upgrading the MPS hardware with either a fully compatible conversion or a totally non-compatible environment alternative. This study considered only the MMS software requirements. The IMCS software in place is developmental and is scheduled to be replaced in the near future. It, therefore, has not been considered in this study. The cost of each of the two alternatives, (1) fully compatible and ~~(2)~~ totally non-compatible, for the MMS were analyzed using the Federal Software Management Support Center's (FSMC's) Conversion Cost Model. The study was performed according to the standards outlined in the FSMC report Preparing Software Conversion Studies - Report OIT/FSCS-84/001. This report describes the development of the cost and staffing schedule requirements for both the compatible and non-compatible conversion alternatives.

17. Key Words	18. Distribution Statement
Software Conversion Study Maintenance Automation Maintenance Processing Subsystem Remote Maintenance Monitoring System	This document is available to the U.S. Public through the National Technical Information Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	112	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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EXECUTIVE SUMMARY

The FAA Remote Maintenance Monitoring System (RMMS) provides automation of current maintenance operations. It provides monitoring and control functions, via the Monitor and Control Software (MCS), and management information functions, via the Maintenance Management System (MMS). The Maintenance Processing Subsystem (MPS) is the host computer system for MMS and MCS. Development of the first phase of MMS is now complete and it is currently being fielded. In addition to this, work with an Interim version of MCS has been proceeding. This ongoing work with the IMCS applications, and the initial implementation of the MMS, has taxed the existing MPS computers to such a degree that they can no longer provide the required services. As a consequence of this it has become necessary to upgrade the current MPS to meet the increased capacity, storage and performance requirements.

This document contains the results of a study performed to determine the costs and benefits associated with two alternative approaches to upgrade the computer hardware at MPS sites. It has been prepared in accordance with the requirements stated in Part 201-30 Management of ADP Resources, Subpart FIRMR 201-30.012-1 and 201-30.012-2 (Amendment 1, December 1984).

The two alternatives addressed in this study are: (1) Compatible Total Inventory Conversion; and (2) Non-compatible Total Inventory Conversion. The first alternative is to add Tandem compatible CPU, memory, and disk units. This will result in a system able to execute all existing software without modification. The second alternative considered is to replace the current systems with another non-compatible (Non-Tandem) system which can meet or exceed the MPS requirements.

It is estimated that the total cost for converting the existing MMS software for the compatible and non-compatible alternatives are as follows:

- o Compatible Total Inventory Conversion $ 294,700
- o Non-compatible Total Inventory Conversion $ 8,181,600

The schedule and average staffing level requirements, as estimated by the Federal Software Management Support Center's (FSMC) Conversion Cost Model, for converting the MMS software for the compatible and non-compatible total inventory conversion alternatives are: (1) The compatible conversion has no schedule requirements and (2) The non-compatible conversion alternative has schedule and average staffing level requirements that range from 6 months with 83.5 staff members to 30 months with 14.8 staff members. The model estimates staffing levels based on duration and vice-versa. The 30 month duration represents the optimum schedule as predicted by the COCOMO Model from the MPS Hardware Upgrade Trade Study (21 October 1986).

1. INTRODUCTION

1.1 PURPOSE

This document provides the results of a study of the costs associated with re-hosting the existing Maintenance Management System (MMS) software. This software is currently resident on the Federal Aviation Administration (FAA) Maintenance Processing Subsystems (MPS).

1.2 BACKGROUND

Since the inception of the airways system, the FAA and its predecessors have conducted intensive preventive maintenance programs to prevent unexpected outages and to minimize disruptions of service to the user. Facilities are visited on a routine basis to read meters, detect and correct deteriorating performance, and to certify that the facility is providing safe and reliable service to the user. Because of the age of the technology involved, this has led to a labor intensive system in which the electronics technician spends a significant part of the workday traveling between the work center and the facility, and between facilities. This problem is compounded by the fact that in order to provide aircraft with the necessary communications, navigation, and radar coverage, many of the facilities are located in remote areas. Therefore, in order to promote efficiency, improve facility reliability, and to provide for more effective utilization of manpower, a remote monitoring capability, coupled with a management information system, was required and initiated.

As described in the National Airspace System (NAS) Plan, the Remote Maintenance Monitoring System (RMMS) enables the FAA to automate its maintenance operations and provide the capabilities described above. The RMMS is a collection of subsystems and equipment distributed throughout the NAS. These provide monitoring and control functions, via the Monitor and Control Software (MCS), and management information, via the MMS, to Airway Facilities (AF) staff at central locations. The MPS is one of the key components of the RMMS. It provides the host computer system for MMS and MCS. Figure 1-1 shows schematically the RMMS architecture.

As part of a phased implementation approach, the FAA has established the RMMS's initial capability by providing Tandem based MPS systems in 38 locations. This initial capability includes 104 individual Tandem NonStop (NS) II processors with associated peripherals distributed over 38 sites.

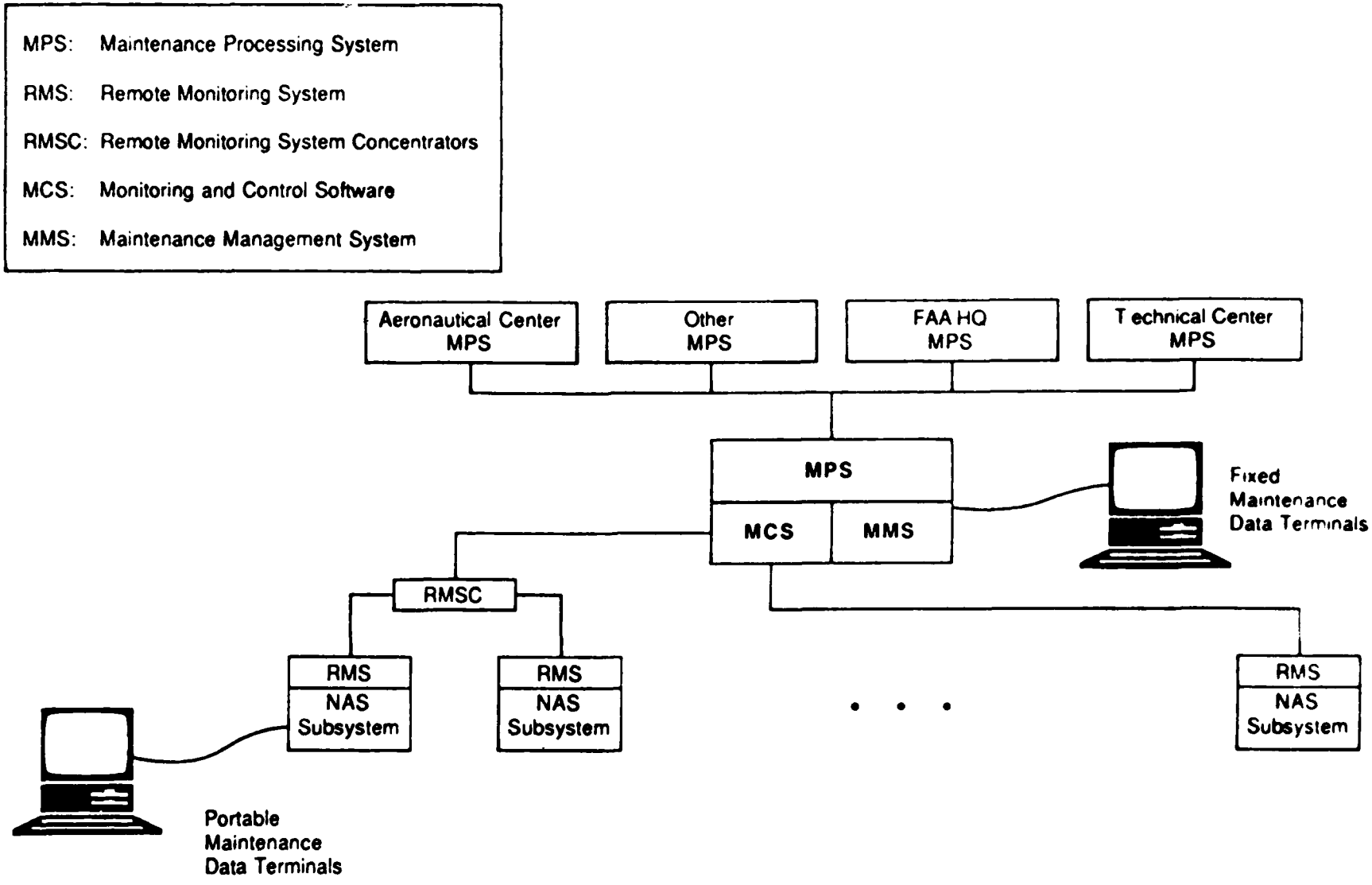

Figure 1-1. Remote Maintenance Monitoring System

1.3 PROBLEM DEFINITION

For the past three years, development of the MMS has beer underway at the FAA. Fielding of Phase I of MMS is now proceeding and will be completed within the 1987 fiscal year. During this same period, enhancements are planned to accommodate new FAA systems which provide remote monitoring capabilities controlled by an Interim version of the Monitoring and Control Software (IMCS). Some of this software became operational in October, 1986. This ongoing growth in the IMCS applications, and the initial implementation of the MMS, has loaded the existing MPS computers to such a degree that they can no longer provide the required services. It has become necessary to upgrade the current MPS to meet the increased capacity, storage and performance requirements.

One consequence of the planned upgrade is the requirement to re-host the existing resident MPS software to new hardware. Depending on the specific upgrade methods selected, which range from simply adding compatible hardware, to total replacement of existing hardware with a non-compatible vendor's product, the scope of rehosting the resident MPS software changes. This study specifically addresses these rehost issues in terms of cost and schedule to convert (rehost) the resident MPS software to a compatible and non-compatible target system.

1.4 ORGANIZATION OF THE AGENCY

Of the 38 MPS sites, 33 are operational at field sites and are under the administrative control of the Regional Office responsible for the Sector in which the MPS site is situated. The field MPS sites are part of the Airway Facilities Sectors of the Airway Facilities Divisions (AXX-400) which are part of the nine Regional Director's Offices. The remaining five sites are National in scope and are considered as support facilities and under the control of the Associate Administrator for Development and Logistics. Figure 1-2 contains a subset of the FAA Organization Chart which depicts those parts of the FAA responsible for the operation and staffing of the MPS sites.

1.5 MISSION OF THE MPS ADP CENTER

By providing greater automation of the maintenance function, the MPS, as part of RMMS, will furnish a vehicle to improve the efficiency and cost effectiveness of maintenance operations.

The MPS provides processing capabilities to support the following functional systems:

- Maintenance Management System (MMS); and
- Monitoring and Control Software (MCS).

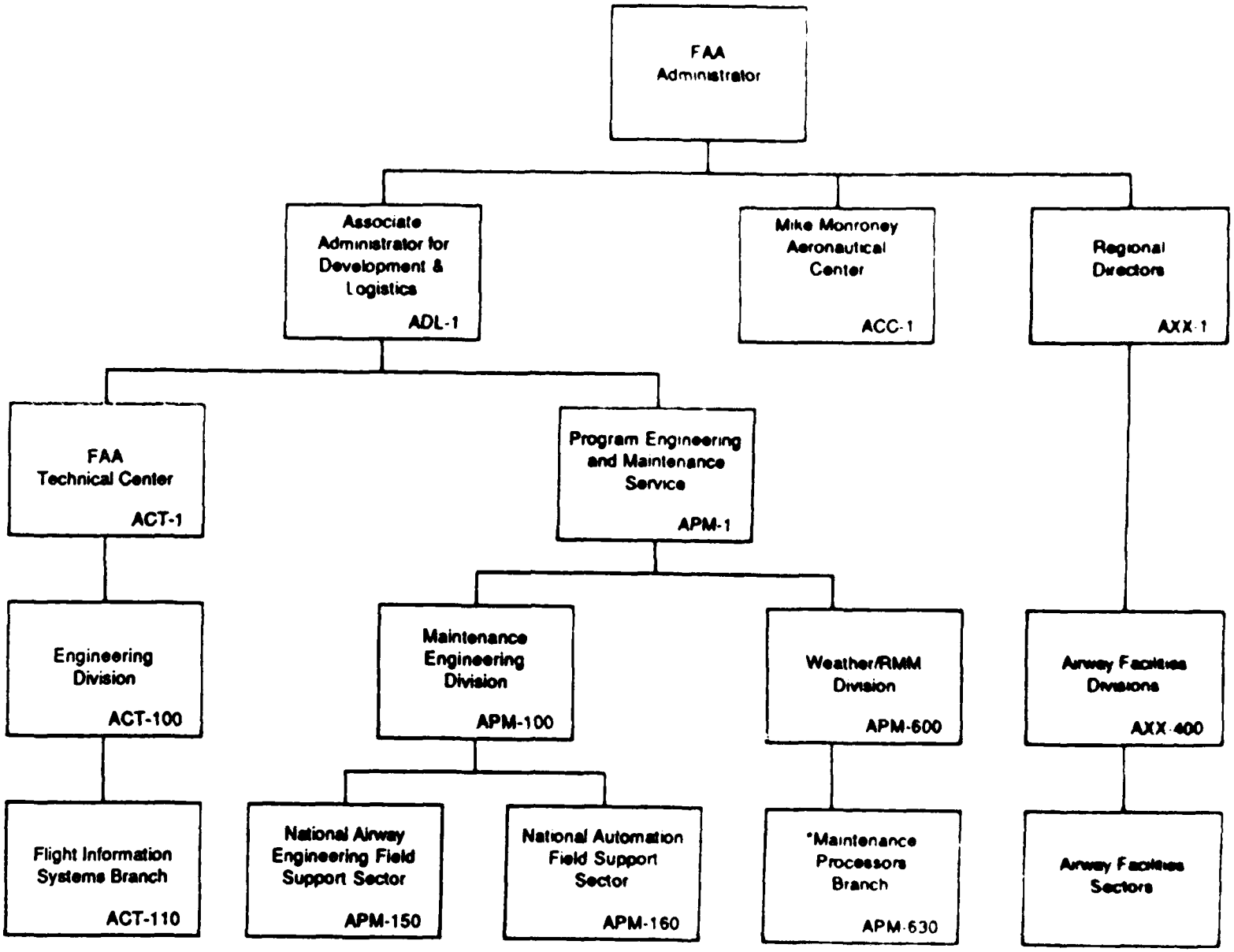

Figure 1-2. Agency Organization

* This function currently being performed by a working group known as the Maintenance Automation Program Office, AXX-1

The objective of the MMS is to improve the overall effectiveness of maintenance of NAS services, facilities, and equipment in support of the 80's maintenance program. It supports improvement of maintenance effectiveness by providing timely and accurate information that facilitates decision making. This information includes performance reports, which provide uniform reporting of service and facility interruptions, and of equipment failure. Redundant reports, both manual and automated, generated by overlapping systems and procedures have been eliminated with the MMS. This reporting capability provides FAA management with the information needed to react to problems posing a potential threat to the performance or effectiveness of the NAS, and to make decisions regarding maintenance policies and procedures for the replacement of equipment. This reporting capability is based upon the automated facility maintenance logs, which expedite the identification and extraction of reportable performance events.

The MCS system will provide the ability to remotely monitor the performance of facilities, measure equipment parameters, when necessary, make compensating adjustments, and predict imminent failure from centrally located consoles. Currently, an interim version of this MCS system (IMCS) is being tested at selected MPS sites. The existing IMCS consists of developmental software to be replaced by the end-state MCS. Since this interim system is scheduled to be replaced in the near future, the cost of converting the IMCS software is not considered in this Software Conversion Study.

1.6 PROCUREMENT HISTORY

In September, 1980, Input Output Computer Services, Inc., (IOCS) of Waltham, Massachusetts, was awarded a contract by the FAA to develop and install the MPS at 25 sites. This was based upon a competitive procurement that was restricted under the terms and conditions of 15 USC 637(a) section 8(a). Two alternative architectures were proposed by IOCS, these were a Tandem based system and a Data General based system. As part of the competitive procurement process, the FAA selected IOCS to develop the IMCS applications software, and Tandem Computers Inc. to supply the hardware and operating system software.

An initial buy for 25 MPS sites (IOCS PO # 920) was made in 1981 with installation during 1982 - 1984. Two General NAS Sector (GNAS) sites purchased systems locally in 1984. An additional buy for 11 more MPS sites (IOCS PO # 2750) was made in late 1984 with installation in early 1985. During the first installation period, the Tandem NS I CPUs were upgraded to Tandem NS II CPUs to utilize newer technology which had just become available. See Form 4 (page 1-6) for the agency MPS procurement history.

FORM 4. PROCUREMENT HISTORY

FAA Maintenance Processing Subsystem Procurement History

Year	Multiprocessor System/CPU		Procurement Method
1982 - 1984	Tandem NS I/II	25 sites	Initial procurement was accomplished by Input Output Computer Services (IOCS) to establish the initial MPS HW capability. Award to IOCS was based on an 8A set aside competitive procurement.
1984	Tandem NS II	2 sites	Purchased locally to provide identical hardware capability
1985	Tandem NS II	11 sites	Add-on Purchase Order to IOCS to provide hardware capability for the remaining MPS sites

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1.8 ASSUMPTIONS AND CONSTRAINTS

The cost figures derived from this study are subject to the assumptions and constraints described herein.

1.8.1 MPS Sites

The 38 MPS sites may be described by the use of one "typical" site. There are minor differences between sites, however, these are small and would have little or no impact upon the conversion costs.

1.8.2 IMCS

The IMCS is developmental software and is scheduled to be totally replaced in the near future. It is unlikely that it would be re-hosted should major recoding become necessary. For these reasons, the cost of converting the IMCS has not been considered in this study.

2. CURRENT ENVIRONMENT

2.1 OPERATING ENVIRONMENT

2.1.1 Users

The MPS sites collect and process information in support of the MMS. MMS users can be divided into four groups: FAA Headquarters personnel, Engineering Field Support Sectors (EFSS), Regional Office personnel, and Sector Personnel.

2.1.1.1 FAA Headquarters Users

Primary users in FAA Headquarters are offices under the Associate Administrator for Development and Logistics (ADL), Systems Engineering Service (AES), Program Engineering and Maintenance Service (APM), and Air Traffic Service (AAT). All users query MMS for standard and ad hoc reports as required. The primary requirements for ADL are the daily interruption reports, analyses based on these reports, and certain information for the NAS Facilities Information System (NFIS) Executive. The primary requirements for AES and APM are the equipment failure reports, the MMS Facilities, Services and Equipment Profile (FSEP) information as needed, interruptions, and other NAS facility and maintenance performance reports. The primary requirements for AAT are the detailed daily interruption and aircraft delay reports. In addition, the National Flight Data Center within AAT receives commissioning and decommissioning data for use in its Flight Information Publications. The MMS Database Administrator (DBA) within AES is responsible for maintenance of the MMS in accordance with system and user requirements. Assisting the DBA in his responsibilities is the MMS National Field Support Group.

2.1.1.2 Regional Office Users

Regional Office users, primarily in the AF Divisions, query MMS for standard and ad hoc reports as required. They also use MMS to inspect NAS Change Proposals (NCPs), Hardware Discrepancy Reports (HDRs), Program Technical Reports (PTRs), and other items entered into the MMS database that require Regional Office evaluation. Subsequent to evaluation, they update the status fields of these items in the MMS database to indicate their disposition (e.g., approved, disapproved, forwarded to FAA HQ). Regional Office users are authorized to modify records in the MMS FSEP that pertain to their region. They enter equipment records into MMS for newly existing equipment when the operational status of the equipment changes. MMS receives technical evaluation schedules and the results of technical evaluations from the Regional Offices (Per Order 1100.127B, Sectors perform technical inspections and, therefore, enter inspection data into MMS).

2.1.1.3 Engineering Field Support Sector Users

These users consist of the National Airway Engineering Field Support Sector (APM-150) located at Oklahoma City, OK, and the National Automation Engineering Field Support Sector (APM-160) located at the FAA Technical Center, Atlantic City, NJ. These organizations are responsible for modifications to FAA facilities and equipment. APM-150 and APM-160 are responsible for modifications to non-automated and automated NAS equipment, respectively. These organizations enter data related to the modification documentation process into MMS. As engineering field support elements, they receive PTRs, HDRs, NCPs and Employee Suggestions from MMS. EFSS personnel also query MMS for trend analysis data and interruption reports to enable them to evaluate the performance of NAS services, facilities and equipment.

2.1.1.4 Sector Users

Air Route Traffic Control Center (ARTCC) Sector, GNAS Sector, and field site employees (e.g., maintenance technicians, maintenance supervisors and crew chief and system engineers (SEs), technicians-in-depth (TIDs), and Sector Managers exercise many of the capabilities of MMS on a daily basis. They enter the following data into MMS: facility maintenance log entries, PTRs, HDRs, NCPs, field stock updates, parts orders, schedule updates (e.g., periodic maintenance), notifications of parts received, FSEP updates, and AF related employee suggestions. They receive configuration management reports, maintenance alerts, and requisition status from MMS.

2.1.2 Facilities

Currently there are 38 MPS installations in the RMMS program which are distributed as follows:

- 23 at ARTCCs
- 10 at Lead Sectors (one per region except at the Central Region where there are two)
- 1 at FAA Headquarters in Washington, D.C.
- 2 at Oklahoma City (1 for APM-150, 1 for the FAA Academy)
- 2 at Atlantic City (1 for APM-160, 1 for ACT-110).

While the individual facilities at each site vary, the characteristics of all the sites are relatively similar. They are as follows:

- All 38 MPS sites have sufficient air conditioning and electrical power and are located on raised flooring;

- The ARTCC as well as the support sites have ample room for expansion; and,

- The Lead Sector sites have greater space constraints and may require a larger room size than other sites for system expansion, as well as increased electrical power and air conditioning.

2.1.3 Processing Modes

All significant MMS processing is done in an interactive mode. A small amount of incidental processing is done in a batch mode in the background. This latter processing includes jobs such as reports.

The primary application is on-line 24 hours a day. This requires major jobs such as data base maintenance to run without shutting down the application. As this precludes batch updating, the update function was coded to coexist with on-line operation of the application and data base.

2.1.4 MPS ADP Center Personnel

The MPS ADP operations are staffed by Systems Maintenance personnel assigned to the 33 Sectors which have MPS facilities. In addition to these operational personnel, key administrative and management, developmental, and systems maintenance personnel are located at other sites. Specifically, these are:

- The FAA Headquarters,
- The 9 Regional Offices,
- The Mike Monroney Aeronautical Center, Oklahoma City, OK, and
- The FAA Technical Center, Atlantic City, NJ.

Refer to Form 9, (next page) for a listing of MPS ADP personnel by function, number, and average GS grade level.

2.1.5 MPS ADP Conventions and Standards

All MMS screen programs have been designed according to the standard format specified in the MMS System Design Document of September 1986. All inter-process messages have a standard header for use by MMS Screen COBOL (SCOBOL) requestors and PATHWAY servers. This convention facilitates Tandem's recovery mechanisms. The integrity of MMS database files are maintained by Tandem's Transaction Monitoring Facility (TMF), and all update operations are performed under its constraints. Refer to System Complexities, Section 2.1.7, for further information.

FORM 9. PERSONNEL

MPS ADP SUPPORT PERSONNEL

Function	Number	Average Grade Level
FAA Headquarters		
Maintenance Processors Branch		
Management/Supervisory	1	GM-15
Engineer	3	GS-14/2
Regional Headquarters (9 Locations)		
Airway Facilities Divisions		
Management/Supervisory	9	GM-15
Engineer	27	GS-14/4
Secretary	9	GS-6/4
MPS Sites (33 locations)		
Airway Facilities Sectors		
Management/Supervisory	33	GM-14
Systems Engineer	33	GS-13/5
Systems Specialist	132	GS-12/6
MPS Support Sites (4 locations)		
National Airway Engineering Field Support Sector		
National Automation Field Support Sector		
FAA Technical Center		
FAA Academy		
Management/Supervisory	4	GM-15
Engineer	16	GS-14/5
Secretary	4	GS-6/4
Total:	267	

2.1.6 Privacy and Security

The MMS Security Subsystem provides controls for:

- limiting entry to the MMS application to those individuals with valid MMS user identities,
- preventing IMCS entry from dial-up terminals, and
- recording access attempts to every MMS Subsystem.

A user is given a specific access level for each of the MMS Subsystems. These levels control whether the user may perform any of the functions in a particular subsystem, and which of those functions may be performed.

2.1.7 System Complexities

MMS Phase 1 software was developed by System Development Corporation (SDC), now doing business under the name Unisys, on Tandem's NonStop II processors. This computer system is a multiprogramming, multiple processor, network oriented system which stresses non stop operation as its major objective. The key features of Tandem's computers are fault tolerance, on-line repair, and modular design. Tandem claims it achieves these through the integration of hardware microcode and the GUARDIAN Operating System.

MMS Phase 1 is an on-line transaction processing system with Tandem's ENCOMPASS Database Management System (DBMS) as its core. As part of the ENCOMPASS system, and integral in the development and operation of MMS Phase 1, the following software products were used:

- DDL (Data Definition Language) - is the vehicle used in designing the data base. The DDL defines the structure of the data base and also maintains the flexibility to adapt the data base structure.

- PATHWAY (Transaction Processing System) - is a group of related software tools that enables a user to develop, install and manage on-line transaction processing applications. PATHWAY performs the following functions:

    -- Oversees transaction work flow;
    -- Controls application access to the TMF;
    -- Provides transaction-processing operator interface;
    -- Provides interactive screen design and screen formatting tools.

- ENFORM (Query Language and Report Generator) - is the query language and report generator for the ENCOMPASS DBMS.

- TMF - is directly coupled with the ENCOMPASS DBMS and it insures that data base integrity is kept. TMF views data base changes as a single unit of work (transaction) and it makes sure that either the transaction is completed in its

entirety or is backed out in its entirety. This ensures data base consistency. In addition, the TMF utility plays a role in Tandem's fault-tolerant system with respect to applications management.

MMS Phase 1 software was developed using PATHWAY and can be considered a PATHWAY system. Therefore, in terms of conversion and re-hosting of MMS Phase 1 software, it is of some importance to generally understand this environment. PATHWAY consists of the following components:

- PATHMON (PATHWAY Monitor) - The central control process that executes PATHCOM commands for the PATHWAY system operations;

- PATHCOM (Command Interface) - The command language interface that is used to communicate with PATHMON and is used to configure requesters and servers;

- Screen COBOL Compiler - The procedural language compiler used by applications programmers to develop screen programs;

- TCP (Terminal Control Process) - The process that interprets and executes the screen programs and controls the terminal I and O devices on which the transaction processing applications run;

- PATHAID - Utility program used to create and modify screen definitions; and

- SCUP (Screen COBOL Utility Program) - Utility program that accesses and manages the screen program object libraries.

The development of MMS in Tandem's PATHWAY environment is significant and adds a degree of complexity that should be considered before a conversion is attempted. The primary capability that the PATHWAY environment provides that would have to be duplicated in a non-compatible target environment is checkpointing. Checkpointing is where backup recovery points are automatically provided for each MMS transaction. The checkpointing capability is automatically provided in the PATHWAY environment through the Transaction Monitoring Facility (TMF). This facility ensures that MMS data base integrity is maintained. MMS uses automatic checkpoints implicit in the SCOBOL code to provide the backup recovery points in the event of a Terminal Control Process (TCP) failure.

2.2 CURRENT SYSTEM INVENTORY

2.2.1 Current Hardware Configuration

MMS runs on the MPS hardware suite which is based on the Tandem NS II computer system. Form 13 (next two pages) provides a typical MPS hardware configuration.

2.2.2 Current Systems Software

2.2.2.1 Operating Systems

MMS runs under the Tandem Operating System (GUARDIAN 90XF EXTENDED FUNCTION PACKAGE). This package consists of four core software products:

- GUARDIAN 90
- ENCOMPASS
- TRANSFER
- EXPAND

Refer to Form 14 (page 2-10) for more detail.

2.2.2.2 Compilers

Compilers currently used include: COBOL (ANSI 74) with Tandem unique extensions that are described in Tandem COBOL Reference Manual, Volumes 1 and 2 of March 1985, and SCOBOL. SCOBOL is Tandem's Screen COBOL and is described in Tandem's PATHWAY Screen COBOL Reference Manual (Part No. 82424 AOO), March 1985. Refer to Form 15 (page 2-11) for more detail.

2.2.2.3 Proprietary Software

The proprietary software tools used by the MMS are those included in the GUARDIAN 90XF package, SCOBOL and COBOL. Refer to Form 16 (pages 2-12,13) for more detail.

2.2.2.4 Database Management Systems

MMS DBMS requirements are satisfied by the Tandem proprietary Database Management System ENCOMPASS. Refer to Form 17 (page 2-14) for more detail.

2.2.3 ADP Systems

MMS Phase I incorporates five basic functions that support the operation and maintenance of equipment and facilities and the upward reporting of outages and interrupts at airway facilities. In addition to the five basic functions, MMS provides a direct interface through the MMS main menu to the IMCS and Tandem's Transfer Mail (Electronic Message System). Each of these functions is briefly described in Form 18 (page 2-15).

FORM 13. CURRENT HARDWARE CONFIGURATION

Typical MPS Site*

Supplier	Model Number	Description	Quantity Per Site	Total Sites
Tandem	1421	NS II, 1MB (2-512 KB) Memory	3	38
Tandem	2420	512 KB Memory	3	38
Tandem	7120	NSII System Cabinet (Old Version)	1	38
Tandem	7301	I/O Only Power Supply	3	38
Tandem	7303	Battery Backup-Memory	3	38
Tandem	6202	Byte Synchronous Controller	1	38
Tandem	6204-1	Bit Synchronous Controller	2	38
Tandem	6303	Asynchronous Controller	3	38
Tandem	6304	Asynchronous Extension Board	4	38
Tandem	7501	Asynchronous Patch Panel	4	38
Tandem	7502	Synchronous Patch Panel	2	38
Tandem	3106	Disk Controller	2	38
Ampex	4104	240 MB Removable Disk	2	38
Tandem	7504	Disk Patch Panel - STD	1	38

13. CURRENT HARDWARE CONFIGURATION (Continued)

Typical MPS Site*

Supplier	Model Number	Description	Quantity Per Site	Total Sites
Tandem	3202	Mag Tape Controller	1	38
Kennedy	5104	Mag Tape Drive, 125 ips	1	38
Tandem	3401	Line Printer Controller	1	38
Data Products	5513	600 LPM Line Printer	1	38
Tandem	6530	CRT/Terminal	4	38

* Typical of the 23 ARTCC sites

Other sites have variations on this equipment. Those with multiple disk drives would have distributed files.

FORM 14. OPERATING SYSTEMS

Supplier	Package Title or Acronym	Version	Remarks
Tandem	Guardian	90 XF	Contains four core software products: i) GUARDIAN 90 ii) ENCOMPASS iii) TRANSFER iv) EXPAND GUARDIAN 90 Includes DP1, DP2, SPOOLER, XRAY, TAL, EDIT, TGAL, SORT, BINDER, CROSSREF, INSPECT, ENVOY, ENVOYACP, TACL, CPU DECIMAL INSTRUCTION SET, CPU STANDARD INSTRUCTION SET. ENCOMPASS Includes DDL, ENABLE, ENFORM, PATHWAY, TMF.

FORM 15. COMPILERS

Supplier	Language	Version	Extensions Used (if known)
TANDEM	COBOL	ANSI 74	USING phrase of the ENTER statement; GIVING phrase of the ENTER statement; LOCKFILE, UNLOCKFILE, UNLOCKRECORD, TIME LIMITS, EXCLUSIVE, SHARED, PROTECTED phrases. Uses file positioning extensions and I/O extensions including lock, unlock and generic positioning for start verb. Uses read and write verb extensions to record level.
TANDEM	SCOBOL	B00	

FORM 16. PROPRIETARY SOFTWARE

Supplier	Package Title or Acronym	Own/ Lease	Cost of Package (if known)	Remarks
TANDEM	GUARDIAN 90XF	Lease	Initial: $11K Monthly: $500	Extended Operating System
TANDEM	ENCOMPASS			DBMS System
TANDEM	DDL			
TANDEM	ENABLE			
TANDEM	ENFORM			
TANDEM	PATHWAY			
TANDEM	TMF			
TANDEM	TRANSFER			Electronic Mail Software
TANDEM	EXPAND			Networking Software
TANDEM	GUARDIAN 90			Basic Operating Software
TANDEM	DP1			
TANDEM	DP2			
TANDEM	SPOOLER			
TANDEM	MEASURE			
TANDEM	TAL			
TANDEM	EDIT			
TANDEM	TGAL			
TANDEM	SORT			

16. PROPRIETARY SOFTWARE (Continued)

Supplier	Package Title or Acronym	Own/ Lease	Cost of Package (if known)	Remarks
TANDEM	BINDER			
TANDEM	CROSSREF			
TANDEM	INSPECT			
TANDEM	ENVOY			
TANDEM	ENVOYACP			
TANDEM	TACL			
TANDEM	CPU DECIMAL INSTR. SET			
TANDEM	CPU STD. INSTR. SET			
TANDEM	COBOL	Lease	Initial: $1K Monthly: $300	

FORM 17. DATABASE MANAGEMENT SYSTEMS (DBMS)

Supplier	Package Title or Acronym	Own/ Lease	Query Language	Cost of DBMS (if known)
TANDEM	ENCOMPASS	Lease	ENFORM	Offered only as part of the GUARDIAN Operating System
TANDEM	DDL			
TANDEM	ENABLE			
TANDEM	ENFORM			
TANDEM	PATHWAY			
TANDEM	TMF			

FORM 18. SYSTEMS

System Name/ Acronym	System Function	Remarks
1. Logging Activity	Provides the mechanism for recording all activities relating to facility maintenance and interrupt reporting.	100% Interactive
2. Periodic Maintenance/ Certification & Scheduling	Provides for the creation and maintenance of files that contain schedules and assignment of personnel and/ or crews to perform periodic maintenance tasks and facility/service certification.	Mostly Interactive/ Some Background Jobs
3. Report Generation	Allows users to generate standard reports for each MMS subsystem	Partially Interactive/Mostly Background Reports
4. Facility, service and Equipment Profile	Maintains a record of all facilities and services within the NAS and generates standard FMF (Facilities Master File) data sets.	100% Interactive
5. Administration	Provides for the control access levels and maintains the reference files.	Mostly Interactive/Some Background Jobs
6. Help	Provides user help screens on each of the program functions.	100% Interactive
7. Security	Provides access control to MMS (Maintenance Management System) and its subsystems, IMCS (Interim Monitoring Control Software) and the electronic message component	100% Interactive
Total Number of Systems: 7		

2.2.4 Applications Software

2.2.4.1 Applications Programs

MMS applications programs to be converted in a non compatible target environment are Logging, Periodic Maintenance, Certification and Scheduling, Report Generation, Facility Service and Equipment Profile, Administration, Help and Security. These software systems comprise a total of 328 SCOBOL programs (214,659 lines of code) and 108 COBOL-74 programs (100,252 lines of code). Of this code, 77% has a higher conversion complexity. Refer to Form 19 (pages 2-17,18) for more detail.

2.2.4.2 Operational Control Languages (OCL)

MMS Operational Control Languages are PATHCOM and PATHMON. Together, these languages have been used to create 1,585 lines of code. Refer to Form 20 (page 2-19) for more detail.

2.2.4.3 Data Files and Databases

There are a total of 36 MMS data files and databases. All files are maintained in ASCII character code and are of a fixed record length.. Of these 36 files, 32 are Indexed Sequential Access Method (ISAM) files, 2 are Sequential Access Method (SAM) files, and 2 are Random Access Method (RAM) file organization. Refer to Form 21 (pages 2-20,21,22,23) for more detail.

2.3 SUMMARY OF SOFTWARE INVENTORY

Table 2-1 contains a summary of the software inventory, which is given in detail in Forms 19, 20 and 21. This includes information regarding database and files, OCL, and languages (DDL, TAL, COBOL and SCOBOL). Section 4 explains the details of the table entries.

FORM 19. APPLICATION SOFTWARE

System	Language	Number of Programs	Lines of Code	Remarks
1. Logging	SCOBOL	21	39,631	
	COBOL-74	18	18,458	Class 2
	TAL			
	DDL			
2. Periodic Maintenance Certification & Scheduling	SCOBOL	6	10,008	
	COBOL-74	4	7,134	53% Directly Transportable
	TAL			
	DDL			
3. Report Generation	SCOBOL	2	3,366	
	COBOL-74	55	44,724	85% Directly Transportable-This Includes code that Replaces Existing ENFORM coding. This is scheduled for completion May 87.
	TAL			
	DDL			
4. Facility Service and Equipment Profile	SCOBOL	11	24,583	
	COBOL-74	15	20,395	Class 5
	TAL			
	DDL			
5. Administration	SCOBOL	8	13,599	
	COBOL-74	11	8,128	Class 5
	TAL			
	DDL			
6. Help	SCOBOL	275	118,594	
	COBOL-74	0	0	
	TAL			
	DDL			
7. Security	SCOBOL	5	4,918	
	COBOL-74	5	1,413	Class 5
	TAL			
	DDL			

19. APPLICATION SOFTWARE (Continued)

System	Language	Number of Programs	Lines of Code	Remarks
MMS TOTAL SYSTEM				
	SCOBOL	328	214,659	Requires Rewrite
	COBOL-74 (Class 2)	}	28,520	Will Need Major Logic Modification Or A Rewrite
	COBOL-74 (Software Transfer-ence)	} 108	71,732	Will Transport Directly
	TAL*	N/A*	1,392	Class 1 - Not Transportable
	DDL*	N/A*	19,567	Class 1 - Not Transportable
Total:		436	335,870	

* TAL and DDL Programs are used throughout the system and are not broken-down by individual programs.

FORM 20. OPERATION CONTROL LANGUAGE

System	Language	Number of Job Streams	Lines of Code
Total MMS	PATHCOM* PATHMON	80	1,585**
	* Includes PATHWAY Configuration ** Includes Command Files to Execute Reports		
Total:	PATHCOM PATHMON	80	1,585

FORM 21. DATA FILES AND DATABASES

System	Number of files	* Access Method	Fixed or Variable	Remarks (include character codes
Logging	Total 5			
	4	ISAM	Fixed	ASCII
	1	RAM	Fixed	ASCII
Periodic Maintenance /Certification & scheduling	Total 5			
	5	ISAM	Fixed	ASCII
Report Generation	Total 2			
	1	ISAM	Fixed	ASCII
	1	SAM	Fixed	ASCII
Facility, Service & Equipment Profile	Total 19			
	19	ISAM	Fixed	ASCII
Administration	Total 2			
	2	ISAM	Fixed	ASCII
Help	0			
Security	Total 3			
	1	SAM	Fixed	ASCII
	2	ISAM	Fixed	ASCII
Total:	36			

* Access method should be designated as SAM (Sequential Access Method), ISAM (Indexed Sequential Access Method, RAM (Random Access Method), or other (please specify).

21 DATA FILES/DATABASES DETAIL INFORMATION

System/ Name	Access Method	Fixed or Variable	Character Code	Remarks
1/ Logging Files = 5				
Log-Entry-Common-Record	ISAM	Fixed	ASCII	No Alternative Keys
Log-Entry-Common-Record	ISAM	Fixed	ASCII	1 Alternative Key
Log-Entry-Header-Record	ISAM	Fixed	ASCII	12 Alternative Keys
Log-Entry-Interrupt-Record	ISAM	Fixed	ASCII	No Alternative Keys
Log-Entry-Number-Record	RAM	Fixed	ASCII	Relative File
2/ Periodic Maintenance/ Certification & Scheduling Files = 5				
Cert-Statement-Record	ISAM	Fixed	ASCII	No Alternative Keys
PM-Master-Record	ISAM	Fixed	ASCII	1 Alternative Key
PM-GLOS-Reference-Record	ISAM	Fixed	ASCII	1 Alternative Key
PM-GLOS-Text-Line-Record	ISAM	Fixed	ASCII	No Alternative Keys
SKED-Record	RAM	Fixed	ASCII	No Alternative Keys
3/ Report Generation Files = 2				
Report-Record Log-Search (LSE)	ISAM SAM	Fixed Fixed	ASCII ASCII	No Alternative Keys

21. DATA FILES/DATABASES - Detail Information (Continued)

System/ Name	Access Method	Fixed or Variable	Character Code	Remarks
4/ Facility Service and Equip. Profile Files = 17				
Cost-Center-Record	ISAM	Fixed	ASCII	1 Alternative Key
Engine-Generator-Record	ISAM	Fixed	ASCII	2 Alternative Keys
Engine-Gen-Arch-Record	ISAM	Fixed	ASCII	No Alternative Keys
Equip-Detail-Arch-Record	ISAM	Fixed	ASCII	No Alternative Keys
Equip-Detail-Record	ISAM	Fixed	ASCII	5 Alternative Keys
FAC-Code-Class-Record	ISAM	Fixed	ASCII	No Alternative Keys
FAC-Serv-Arch-Record	ISAM	Fixed	ASCII	No Alternative Keys
Facility-Service-Record	ISAM	Fixed	ASCII	3 Alternative Keys
FAC-Supplement-Record	ISAM	Fixed	ASCII	No Alternative Keys
FAC-Supp-Arch-Record	ISAM	Fixed	ASCII	No Alternative Keys
Facility-Type-Record	ISAM	Fixed	ASCII	No Alternative Keys
LOC-Ident-Record	ISAM	Fixed	ASCII	1 Alternative Key
Module-Detail-Arch-Record	ISAM	Fixed	ASCII	No Alternative Keys
Module-Detail-Record	ISAM	Fixed	ASCII	No Alternative Keys

21. DATA FILES/DATABASES - Detail Information (Continued)

System/ Name	Access Method	Fixed or Variable	Character Code	Remarks
Precomm-FAC-ARCH-Record	ISAM	Fixed	ASCII	No Alternative Keys
Precommission-FAC-Record	ISAM	Fixed	ASCII	2 Alternative Keys
Short-Name-Record	ISAM	Fixed	ASCII	1 Alternative Key
5/ Administration Files = 4				
Associated-Related-FAC-Record	ISAM	Fixed	ASCII	1 Alternative Key
Facility-Authorization-Record	ISAM	Fixed	ASCII	1 Alternative Key
Line-Frequency-Record	ISAM	Fixed	ASCII	3 Alternative Keys
MMS-Personnel-Record	ISAM	Fixed	ASCII	No Alternative Keys
6/ Help Files = 0				
7/ Security Files = 3				
Access-Log--Record	SAM	Fixed	ASCII	2 Alternative Keys
Security-Access-Record	ISAM	Fixed	ASCII	No Alternative Keys
System-PARAM-Record	ISAM	Fixed	ASCII	No Alternative Keys

TABLE 2-1

Summary of Software Inventory Complexity

DATA FILES

CONVERSION COMPLEXITY CLASS	NO. OF FILES
A	36
B	0
C	0
D	0
E	0
Total data files =	36

OPERATIONAL CONTROL LANGUAGE

COMPATIBILITY CLASS	LINES OF CODE
1	1585
2	0
3	0
4	0
5	0
Total lines of OCL =	1585

CODE

CONVERSION COMPLEXITY CLASS	TAL	DDL	COBOL	SCOBOL
1	1392	19567	0	214659
2	0	0	28520	0
3	0	0	0	0
4	0	0	0	0
5	0	0	71732	0
Total lines of Code =	1392	19567	100252	214659

3. TARGET ENVIRONMENT

3.1 FUNCTIONAL DESCRIPTION

The non-compatible and compatible target system environments must provide all the capability available today as well as meeting the following requirements.

3.1.1 Hardware Functionality

The processing modes for the target system must support time sharing, interactive processing, and batch processing. The equipment selected must be capable of accommodating the present workload as well as the near term projected workload imposed by IMCS, its replacement MCS, and increased use of MMS Phase 1. In order to accommodate future workload increases, the hardware must also be readily expandable in Central Processing Unit (CPU) processing and disk storage capacity.

Both historical and backup data must be stored. This will be achieved using a removable storage media such as magnetic tape and removable hard disks. The target system must support this capability.

As MMS Phase 1 is brought into greater operational use, an increasingly large amount of data will need to be stored and maintained. It is required that the target hardware be able to accomplish this with a minimal degradation in the responsiveness and performance of the system.

The target system must be made of proven state-of-the-art hardware that can be supported for the expected life of the system.

3.1.2 Software Functionality

3.1.2.1 MMS Software Functionality

The target system must provide the functionality of the current MMS Phase 1 software. This includes all functional, performance, security, and human interface requirements.

3.1.2.2 Operating Systems

The target operating system must provide the following functions:

- Preparing program files;
- Providing file security, control access by user profiles;
- Scheduling CPU time for processes based upon their assigned priorities;
- Enabling application processes to start other processes;
- Managing virtual memory;
- Enabling interprocessor communication;
- Providing system resources to execute processes; and
- Managing system resources and resolving demands for competing processes.

3.1.2.3 Proprietary Software

The target vendor must provide functionally equivalent or similar packages for all proprietary software as described in Section 2.2.2.3 of this document.

3.2 OPERATING ENVIRONMENT

No changes in the operational environment are planned between the current and target environment.

It is unlikely that the number of FAA personnel operating the Maintenance Processing Subsystem will be increased beyond the current level. Therefore, it is necessary that the target system require minimal manual support.

3.3 OTHER REQUIREMENTS

The target hardware and software shall include fault tolerant schemes equal to or better than those currently provided to ensure continuous operation and the maintenance of data integrity following a failure.

4. CONVERSION COST ESTIMATING

This section contains the methodology used in estimating the conversion costs, the different procurement alternatives and a description of each of the conversion tasks. It is comprised of the following Subsections: 4.1 Conversion Costing Methodology; 4.2 Explanation of Procurement Alternatives; and 4.3 Conversion Tasks.

4.1 CONVERSION COSTING METHODOLOGY

The Federal Software Management Support Center's (FSMC's) Conversion Cost Model (Version 4) was used to estimate conversion effort and cost for conversion of MMS (Phase 1) software both to a fully compatible and to a non-compatible host environment. The model provides conversion estimates in the following main cost areas:

- Staff resources;
- Machine resources; and
- Miscellaneous resources.

The costs associated with staff resources are for the actual manpower required to accomplish each of the conversion tasks. Machine costs are the costs associated with the use of computer resources for the completion of the conversion tasks. Miscellaneous costs includes such items as supplies, materials, travel and per diem, Automated Data Processing Equipment (ADPE) lease and maintenance for dual operation or conversion, site preparation, system transition, training, etc. Miscellaneous costs are site dependent and unique to each conversion effort.

For each of the cost areas discussed above the model provides estimates for the following baseline conversion tasks:

- Conversion Planning and Analysis;
- Inventory and Conversion Study Preparation;
- Work Package Identification and Preparation;
- Test Data Generation and Validation;
- Application Program and System Software Conversion;
- Data File and Data Base Conversion;
- Operation Control Language Conversion;
- Redocumentation;

- System Testing;
- Acceptance Testing;
- Site Preparation;
- System Transition;
- Conversion Training;
- Conversion Management and Administrative Overhead, and/or Contract Administration and Support; and
- Conversion Tools and Aids.

4.1.1 Model Background

The Conversion Cost Model (Version 4) is a result of extensive analysis and research by the Federal Conversion Support Center (FCSC) now the FSMC. They analyzed current state-of-art cost estimating techniques for use by the Federal government. None of these was found to be totally satisfactory for the Federal government's needs. They were found to be outdated, poorly documented, highly subjective and/or not necessarily structured toward the tasks involved in doing a conversion. The FCSC, as part of the U. S. General Services Administration (GSA) and as mandated by the Federal Information Resources Management Regulations, developed a standard set of conversion tasks (given above) and developed a cost model for estimating the resources required to accomplish these tasks. This standard set of conversion tasks is the methodology the government employs in conversion planning, conversion estimating and for the actual conversion efforts.

The model was developed to support and to do estimates for the work breakdown structure employed by the Federal government for conversion efforts. The model is parametrically driven and is designed so that the number of independent variables are held to a minimum while maintaining maximum flexibility. The overall effect of this model design is to have a model that can be utilized in the early stages of acquisition and conversion planning when specific information is not available, i.e., the target system, to the later stages when the detailed information is known. As actual information becomes known the nominal values assigned to subjective parameters (variables) can be refined. Also, as tasks are completed their associated costs can be eliminated from the estimate. This allows the user to tailor the model to each particular application and to get more accurate conversion cost estimates as the process evolves.

The algorithms used for conversion resource estimating are given in Tables 4-2 and 4-3 for the compatible and non-compatible conversion alternatives respectively.

4.1.2 Personnel Costs

The following FSMC default values were used in the Cost Conversion model for staff-day, staff-year and yearly salary rate in the performance of this study:

- A staff-day (SD) equals 8 staff-hours (SH);
- A staff-year (SY) equals 240 staff-days (SD) and/or 1920 staff-hours; and
- The model default salary rate of $72,000 was used. This represents a mixture of skill levels of government and contractor personnel working in a large metropolitan area.

The model does not differentiate between work performed by the government and work performed by a contractor. Staff-years are based on the above assumptions and can be found for the compatible and non-compatible conversions in Tables 4-2 and 4-3 respectively.

4.1.3 Machine Costs

Machine resource costs are dependent on many factors including;

- Source and target environment;
- Complexity of the conversion;
- Size of the conversion project;
- Conversion project completion schedule;
- Amount of machine resources available; and
- Dedication of the personnel and machine resources to the conversion project.

The model assumes that the machine usage is directly proportional to the staffing resource estimates. A percentage between 0 and 50 percent (with a model default of 10 percent) is applied to the staff costs for each of the respective tasks to estimate machine resource costs.

For the purposes of a conversion effort machine resource costs are calculated for the following tasks:

- Conversion Planning and Analysis;
- Work Package Identification and Preparation;
- Test Data Generation and Validation;

- Application Program and System Software Conversion;
- Data File and Data Base Conversion;
- Operation Control Language Conversion;
- System Testing; and
- Acceptance Testing.

FSMC's recommended default percentage of 10 percent was used to estimate machine resource costs for each of the above tasks.

4.1.4 Model Input Data

For the purposes of estimating the compatible and non-compatible conversion costs for the MMS, information was gathered from the following sources:

- The Maintenance Management System Design Document, ES-86-16, September 1986;
- Functional Specification for the Maintenance Management System, June 1984;
- Maintenance Processing System Hardware Upgrade Trade Study Report, October 21, 1986;
- The Maintenance Management System Specification (Requirements), FAA-E-2734-A, February 1986; and
- Meetings with the Maintenance Management System Software developers, Unisys (formerly System Development Corporation - SDC).

The inputs and assumptions for each of the conversion tasks are discussed in the following sections. A summary of the information obtained from the FAA and Unisys (who assisted the FAA) is given in Forms 23 and 29-32 contained in Section 7. Model inputs for both the compatible and non-compatible alternatives are given in Figures 4-1 and 4-2, respectively.

4.2 EXPLANATION OF PROCUREMENT ALTERNATIVES

The procurement alternatives analyzed for this study are fully Tandem compatible and non-Tandem compatible alternatives. For the compatible alternative the target hardware environment would be Tandem TXPs or equal. This represents an upgrade from the existing Tandem NonStop (NS) IIs. The non-compatible alternative would have a target hardware environment that is not Tandem. The Cost Conversion Model (Version 4) was run to estimate conversion costs for each of these procurement alternatives.

4.2.1 Compatible Total Inventory Conversion

A compatible total inventory conversion is the analysis of costs, tasks, benefits and risks involved in moving applications software, data files and data bases from the MPS Tandem NS IIs to an upgraded but similar Tandem MPS site. For the purposes of this study it is assumed that the Tandem TXP will be the compatible processor.

4.2.2 Non-compatible Total Inventory Conversion

A non-compatible total inventory conversion is the same as a compatible total inventory conversion with the exception that the assumed processors would be non-Tandem equipment. This equipment would meet the requirements as specified in the NAS System Specification and the Remote Maintenance Monitoring System Core System/Segment Specification (14 July 1986). It is in these documents that the requirements for fault-tolerant equipment is described.

4.3 CONVERSION TASKS

This section describes in detail each of the conversion tasks that the Cost Conversion Model (Version 4) estimates. It gives an overview of each conversion task, discusses any assumptions made for that task, gives the respective model inputs for that task and gives the model results for the task. Each of the conversion tasks are broken out by the compatible and non-compatible alternatives.

4.3.1 Conversion Planning and Analysis

The conversion planning and analysis task consists primarily of developing a plan for converting the application systems, programs and data. It also consists of review and revision of existing conversion policies, procedures, and standards; definition, development and implementation of new policies, procedures and standards; preparation of a detailed description of the work to be performed; identification of all programs, files, data bases, documentation and test data which should be included in the work packages; selection of conversion priorities; and preparation of a schedule. Each of the above tasks is done at the project, system and system component level. Each system and system component (i.e., program, file and job stream) should be analyzed for the effects of such differences as word size, arithmetic precision, character code, format and alignment, site unique utilities and machine dependencies. They should also be analyzed for any redesign potential. The review of policies and procedures should address items such as how maintenance changes are to be managed during conversion; whether and how program changes are frozen during conversion; program and file naming conventions; and programming standards.

4.3.1.1 Compatible Conversion

The default of 1 staff-day per system (S), 1/2 staff-day per program (P) and 1/2 staff-day per job stream (J) was used in calculating costs for the conversion planning and analysis task. The total cost for this task was $87,100 for a compatible conversion. It was arrived at by multiplying the 1.1 staff-years, generated by the model (from Table 4-2), by the FSMC recommended default yearly salary rate of $72,000 and adding 10 percent for machine costs.

4.3.1.2 Non-compatible Conversion

The default settings used for the compatible alternative were also used in the non-compatible conversion model run. The total cost for a non-compatible conversion for this task was $182,200. It was arrived at by multiplying the 2.3 staff-years, generated by the model (from Table 4-3), by the FSMC recommended default yearly salary rate of $72,000 and adding 10 percent for machine costs.

4.3.2 Inventory and Conversion Study Preparation

The inventory and conversion study preparation task includes: data collection for the inventory; preparation, summarization, analysis, and validation of the inventory; analysis of the software and files inventoried, including their potential for conversion, redesign, or purge, and identification of any duplication of code; research and analysis of the source and target environments, especially to determine the compatibility that may exist; and the preparation and writing of the conversion study. Collection of the data was done by the FAA with Unisys' help. The cost of the Inventory and Conversion Study Preparation Task is $67,400. This task cost applies to both the compatible and non-compatible conversion alternatives.

4.3.3 Work Package Identification and Preparation

The work package identification and preparation task is made up of four basic components. They are: defining the work package and its elements; identifying all programs, files, documentation, test data, etc., which should be included in each work package; physically assembling each work package and its elements in machine readable format; and establishing an inventory and control system for the work packages which will be used to control the software, monitor the conversion status, and to track maintenance changes and project progress.

Each work package should be large enough to encompass a functional area (i.e., system or subsystem) and should contain enough information to allow the system conversion staff to: adequately define what is to be converted; understand the system/subsystem functions; identify all system/program documentation requiring redocumentation; and test the converted work packages to ensure that conversion was successful.

In a completely compatible conversion, the work package identification and preparation task is not required. Where there is some compatibility between the source and target environments this task may be bypassed or considerably reduced. The rule of thumb is, if there is unit or system testing to be done, then the work package identification and preparation and test data generation and validation tasks are required.

4.3.3.1 Compatible Conversion

Work package identification and preparation is not required for the compatible conversion; therefore, no costs would be incurred.

4.3.3.2 Non-compatible Conversion

For a non-compatible conversion the model default values of 3 staff-days per system (S) and 1 staff-day for every 10 system components (i.e., programs, files and job streams) were used. For a non-compatible conversion the total cost for work package identification and preparation is $23,800. This was derived by multiplying 0.3 staff-years, generated by the model (from Table 4-3), by the FSMC recommended default yearly salary value of $72,000 and adding 10 percent for machine costs.

4.3.4 Test Data Generation and Validation

The test data generation and validation task involves the creation, preparation and generation of test data sets to validate the converted programs, files and systems. In most cases the test data is prepared and generated on the source computer, therefore the transfer of this data to the target system should be considered. The test data generated should be small enough in volume to minimize testing costs, but thorough enough to exercise the required percentage of code. The test data required (TDR) for the MMS conversion should exercise 77.5 percent of the overall program logic paths for the non-compatible conversion. The overall value of 77.5 percent was derived by taking the percent of required test data for each subsystem (from Form 23) and weighting the individual percent by the testing effort required for each respective subsystem (from Form 23) and averaging across subsystems to get the overall value of 77.5.

4.3.4.1 Compatible Conversion

Test data generation and validation costs would not be incurred for the compatible conversion since testing is not required.

4.3.4.2 Non-compatible Conversion

The following information was used for the non-compatible conversion of MMS in regards to the test data generation and validation task:

- 74 percent of the code is exercised by existing test data (from Form 23 -information provided by the FAA);
- The test data required must exercise 77.5 percent (discussed above) of the logic paths;
- The overall percentage of available documentation is 88 percent (obtained from Form 32); and
- Model defaults were used for estimating effort and cost for test data generation and validation.

For the non-compatible conversion the test data generation and validation task cost is $47,520. This was derived by multiplying the 0.6 staff-years, generated by the model (from Table 4-3), by the FSMC recommended default yearly salary rate of $72,000 and adding 10 percent for machine costs.

4.3.5 Application Program and System Software Conversion

The application program and system conversion task consists primarily of the following activities: software translation, generation or transference; software compilation and debugging; program level redocumentation; and unit level testing with test data. The testing should ensure that 77.5 percent of the program logic paths are tested, including all of the logic paths that are most frequently used. The MMS application programs to be converted include software written in Tandem's SCOBOL, ANSI COBOL 74, Tandem's Transaction Application Language (TAL), and Tandem's Data Base Management System's data definition language (DDL). It is assumed that the target environment will provide functionally equivalent system software and that Tandem's system support software used by MMS, including Electronic Mail, will not need to be converted. Tandem's proprietary software may have to be converted if equivalent software cannot be provided on the target system.

There are three key factors that affect the conversion of applications programs and system software. They are:

- Conversion complexity;
- Documentation status; and
- Productivity rates (manual and automatic translation).

It should be noted that software conversion complexity increases with program logic dependence upon features and characteristics unique to the source computer and its environment. There are five classes of software complexity. In decreasing order of complexity they are defined as:

CLASS 1. Reprogramming;

CLASS 2. Major program logic modification;

CLASS 3. Minor program logic modification;

CLASS 4. Simple syntax translation; and

CLASS 5. Software transference.

An average documentation percentage of 88 percent (from Form 32) and all FSMC model default values for productivity rates were used in estimating the costs to convert the MMS application programs.

4.3.5.1 Compatible Conversion

For the compatible conversion the conversion complexity of all application programs was classified as Class 5 (Software Transference). Therefore no conversion costs would be incurred because of software transference to the target environment.

4.3.5.2 Non-compatible Conversion

For the non-compatible software conversion the following information was used in the model:

- Model defaults were used in the calculation of the effort and cost for the application program and system software conversion task;
- The total number of systems and programs are 7 and 436 (from Form 29), respectively;
- SCOBOL program modules totaled 328 with 214,659 lines of code classified as Class 1 (from Form 29);
- COBOL program modules totaled 108 with 71,732 lines of code classified as Class 5 and 28,520 classified as Class 2 (from Form 29);
- There were 1,392 lines of TAL code which were classified as Class 1 (from Form 29). Number of program modules is not applicable;
- There were 19,567 lines of Tandem DDL all classified Class 1 (from Form 29). Number of program modules is not applicable;

- Percent automatic translation for all of the software languages is assumed to be zero; and

- System software is assumed to be provided on the target system and not converted.

Zero percent automatic translation for all of the software was used because (1) the SCOBOL, TAL and DDL are all Tandem unique products and (2) the COBOL code that is not directly transportable primarily does data base I/O (Input/Output) and makes significant calls to vendor unique utilities and extensions. The SCOBOL, TAL and DDL code were given a complexity class rating of 1 because these are Tandem unique products and would require a rewrite. The COBOL code that was classified as Class 2 primarily performs the I/O to the MMS data bases and files. Since the DBMS is a Tandem product, a new DBMS would be used on the target system. This would require at a minimum major modification to the existing code to interface with the new DBMS. As stated above, it was assumed that the system software would be provided with the target system and not transferred.

For non-compatible conversion the total cost for conversion of the application programs is $1,726,600. This was obtained by multiplying the 21.8 staff-years, generated by the model (from Table 4-3), by the FSMC recommended default yearly salary rate of $72,000 and adding 10 percent for machine costs.

4.3.6 Data File and Data Base Conversion

The data file and data base conversion task consists of: detailed file and data base analysis; data file and data base conversion or transfer; file level redocumentation; and unit testing of file and data base conversion. The three major factors affecting the conversion of data files and /or data bases are complexity, the existence of any data description or data dictionary language and the availability of good up-to-date documentation. Just as with software complexity, data file and data base conversion complexity increases with increasing dependence on features and characteristics unique to the source computer and its environment. The five basic classes for file conversion are, in decreasing order:

CLASS A. Very complex translation;

CLASS B. Complex translation;

CLASS C. Average complexity translation;

CLASS D. Simple translation; and

CLASS E. File transference.

There are 19,567 lines of data dictionary language (from Form 29) for Tandem's DBMS, ENCOMPASS. This package is Tandem proprietary and would not be transferable to the target environment. Since the target environment is not known it is impossible to estimate the costs for repurchasing the DBMS and DDL packages. There would also be effort required to develop and write the new DDL for the converted files. Therefore, the 19,567 lines of Tandem DDL have been included in the application program and system software conversion task to estimate the cost to rewrite the DDL. Also, an overall average documentation percentage of 88 percent was used in estimating the cost for data file and data base conversion.

4.3.6.1 Compatible Conversion

No costs are incurred for the data file and data base conversion task for a compatible conversion. This is because all files and data bases move to the target environment by file transference.

4.3.6.2 Non-compatible Conversion

For the non-compatible conversion there are 36 total files all classified as Class A (from Form 31). They are all classified as Class A because they are all part of Tandem's relational DBMS environment, ENCOMPASS. It states in the Cost Conversion Model (Version 4) Cost Model Handbook that conversion of data base management system files or data bases are very complex conversion and should be assigned a complexity rating of Class A. All model defaults were used in calculating the cost of the data file and data base conversion task.

The total cost of the data file and data base conversion task for a non-compatible conversion is $103,000. This was obtained by multiplying the 1.3 staff-years, generated by the model (from Table 4-3), by the FSMC recommended default yearly salary rate of $72,000 and adding 10 percent for machine costs.

4.3.7 Operation Control Language Conversion

The OCL conversion task includes: analysis; translation, generation, or rewrite; operating level redocumentation; and unit level testing. The degree of effort involved in transfer of OCL from the source to the target environment is a function of the complexity of the source and target environments, the availability of adequate operations documentation and the productivity rates (both manual and automatic translation) for conversion. Unless the source and target environments are identical or highly compatible it is assumed that all OCL will require a rewrite or reprogramming to some degree. This is due to the many factors that affect OCL conversion and the high variability between vendor operating systems. The estimating methodology for OCL conversion is identical to that of application program and system software conversion. The five levels of complexity of OCL conversion are:

CLASS 1. Reprogramming or rewrite;

CLASS 2. Major program logic modification;

CLASS 3. Minor program logic modification;

CLASS 4. Simple syntax translation; and

CLASS 5. Software transference.

4.3.7.1 Compatible Conversion

For the compatible OCL conversion, all OCL is assigned a complexity rating of Class 5. Therefore, all OCL is transferred to the target environment by software transference and no costs are incurred for the compatible conversion.

4.3.7.2 Non-compatible Conversion

For the non-compatible OCL conversion task, the overall documentation percentage of 88 percent (from Form 32) and the model default values for estimating OCL conversion were used. For conversion to a non-compatible environment it was assumed that the 1,585 lines of Tandem OCL were Class 1 (requires rewrite) complexity with zero percent automatic translation (from Form 30). The total cost for the Operation Control Language task for a non-compatible conversion is $7,900. This was derived by multiplying the 0.1 staff-years, generated by the model (from Table 4-3), by the FSMC recommended yearly salary default rate of $72,000 and adding 10 percent for machine costs.

4.3.8 Redocumentation

The scope of the redocumentation task includes the overall system and project level redocumentation and consists of changing technical, user, and operational documentation to reflect changes between the source and target environments. It does not include redocumentation at the unit level which is included under each specific task (previously discussed), nor does it include enhancing or updating out-of-date documentation or creating documentation where it was nonexistent. For this study it was assumed that both technical and clerical staff will be required.

4.3.8.1 Compatible Conversion

For the redocumentaton compatible conversion task no costs would be incurred since redocumentation is not required.

4.3.8.2 Non-compatible Conversion

For the non-compatible conversion the overall documentation percentage of 88 percent was used. The model defaults of 1 staff-day for every 4 programs and 1 staff-day for every system

for the technical portion, and 1 staff-day for every 2 programs and 2 staff days for every system for the clerical portion were used to calculate redocumentation costs. In addition, the model default of 10 percent was used to estimate the effort involved for redocumentation coordination.

The total cost for the non-compatible conversion redocumentation task is $100,800. This was obtained by multiplying the 1.4 staff-years, generated by the model (from Table 4-3), by the yearly FSMC recommended salary default rate of $72,000. There are no machine costs associated with this task.

4.3.9 System Testing

After unit testing for all programs, files and operation procedures have been completed (during software and file conversion tasks), the system test can be conducted. System testing is full application system testing conducted with system test data which involves all system components. It requires the execution of the full system to demonstrate the inter-operability between system components (programs, files and job streams) and overall correct execution. Once system testing is completed, the system will function as expected. It should be noted though, that system testing does not guarantee every detailed result to be correct. After system testing has been completed, the system would enter into software acceptance testing.

There is no predetermined timeframe or duration for system testing. System testing, though, may be required to restart many times in order to achieve acceptable output. This restart condition is referred to as the system test rerun factor. System testing is not required for compatible conversions.

4.3.9.1 Compatible Conversion

For the compatible conversion all programs, files and OCL are transferred to the target system without modification. Therefore, system testing is not required and no costs are incurred for the compatible conversion system testing task.

4.3.9.2 Non-compatible Conversion

The number of reruns used for MMS non-compatible system testing was 5 (FSMC recommended model default). Model default values of 1 staff-day per 2 systems and 1 staff-day per 80 system components (the total number of programs, files and job streams and independent runs) were used.

The total cost for the non-compatible conversion system testing task is $126,700. This was obtained by multiplying 1.6 staff-years, generated by the model (from Table 4-3), by the FSMC recommended yearly salary default rate of $72,000 and adding 10 percent for machine costs.

4.3.10 Acceptance Testing

The acceptance testing task is for software conversion only (hardware acceptance testing should have been previously completed) and involves all converted system components (i.e., converted programs and job streams), all operating instructions and procedures, revised documentation and converted live data files and data bases. Acceptance testing computer runs should be duplicating parallel or previous runs on the source computer. The duration of acceptance testing may be set for any length of time, but consideration must be given to staffing levels for the task and for any external or internal time constraints. Site preparation and system transition task plans, schedules and logistics should be coordinated precisely with the acceptance testing schedule. Acceptance testing is not required for a compatible conversion.

4.3.10.1 Compatible Conversion

Since the source system software, files and data bases are directly transferred and are not converted to the target environment, system acceptance testing is not required. Therefore, no costs are incurred for the compatible conversion acceptance testing task.

4.3.10.2 Non-compatible Conversion

For the non-compatible conversion acceptance testing task it was assumed that the duration of acceptance testing would be 90 days. The model default values of 1 staff-day for every 8 systems for the duration of acceptance testing, 1 staff-day for every job stream, and 1 staff day for every 5 programs and files were used. It should be noted that the programs and systems are not tested individually, only the job streams and all the programs and files grouped together are tested during acceptance testing.

The total cost for the non-compatible acceptance testing task is $79,200. This is calculated by multiplying 1.0 staff-years, generated by the model (from Table 4-3), by the yearly salary default rate of $72,000 and adding 10 percent for machine costs.

4.3.11 Site Preparation

The site preparation task includes all activities associated with the required modifications to the computer room(s) to support the target hardware environment. Site preparation may be required not only for the final computer room setup, but also for the conversion effort and system transition. Site preparation activities include:

- Review of architectural, mechanical and electrical plans;
- Review of floor loading and raised floor requirements;

- Review of requirements for temperature and humidity control; and

- Review of requirements for special power conditioning, heat dissipation and backup power.

4.3.11.1 Compatible Conversion

The compatible conversion involves an upgrade from Tandem NS IIs to Tandem TXPs. In general, the current site configuration is adequate and will require only minor modifications for the compatible system. For the purposes of this study, it is assumed that the total cost for the compatible conversion site preparation task is $133,000 ($3,500/site x 38 sites). This figure was obtained from Tandem.

4.3.11.2 Non-compatible Conversion

Under the non-compatible conversion alternative, the target system will be a new hardware suite (non-Tandem) from the source system (Tandem Equipment). Since the target system is unknown at this time, it is very difficult to pinpoint the exact site preparation costs. In discussions with potential target system vendors, it was learned that 1/2 percent of the hardware costs can be used to estimate site preparation costs. Using a hardware cost of $2,159,091 per site (from the MPS Trade Study - represents a median hardware cost of all the vendors reviewed), and multiplying it by 1/2 percent gives a site preparation cost of $10,795 per site. Multiplying the site preparation cost by 38 (total number of MPS Sites) gives an approximate total site preparation cost of $410,210.

4.3.12 System Transition

The system transition task involves the migration from the source system to the target system. The three most widely used methods of system transition are:

- Complete parallel or dual operations;

- Immediate transition; and

- Phased parallel or dual operations.

Complete parallel or dual operations involves the operating of the source and target systems concurrently during the transition period. This is normally the most desirable method and represents the low risk, high cost alternative. Immediate transition involves the immediate cutover from the source system to the target system. This technique is the most risky but, if done correctly, represents the low-cost technique. The phased parallel is a compromise approach where the system is converted in phases (only part of the system is converted at a time) and parallel operations are performed on each part until the entire system is converted and acceptance testing is complete. The

phased parallel or dual operations approach is less risky than immediate transition and can be more or less costly than the parallel operations technique depending on how long the phased approach takes.

Due to the importance of the MMS and the criticality of the functions it performs for the NAS, the system transition approach chosen was complete parallel operations for 60 days.

4.3.12.1 Compatible Conversion

The system transition strategy used for the compatible conversion is immediate transition which results in a transition period for the compatible conversion of one day. Therefore, no costs are incurred for compatible conversion system transition.

4.3.12.2 Non-compatible Conversion

The strategy chosen for system transition for the non-compatible environment is completely parallel or dual operations for 60 days. There will be significant costs associated with maintaining dual data centers for 60 days. The total cost for the non-compatible system transition is $58,280. This figure takes into account $11,280 for lease of the new equipment, $24,000 for two months of FAA personnel salary to support parallel operations, $2,000 for additional power requirements, $8,000 for additional floor space (if required) and $13,000 for two months of maintenance (from the MPS Hardware Upgrade Trade Study).

4.3.13 Conversion Training

The conversion training tasks involves the retraining of personnel for the target system. For this study, training only applies to the non-compatible conversion alternative since no training is required for the compatible conversion. There are basically two types of training: 1) training to perform conversion-related activities and 2) training designed to retrain personnel to develop comparable skills in the target environment.

Training for conversion-related activities would include training to a team of conversion personnel in the use of automated conversion tools (not applicable for this conversion); instructions for manual conversion of software; quality assurance techniques; and target system software (includes operating system, database management system, software language and general development environment).

The retraining of FAA personnel would include the training of at least two FAA staff members from each of the 38 MPS sites in: operating system and hardware overviews, operator training, capabilities of the new system and differences from the old system, operation procedure languages, language compilers, and database management systems. The FAA has indicated that

approximately 100 staff personnel would require training for the non-compatible conversion alternative.

MMS functional user training will not be required for either conversion alternative since the software will appear the same to the user.

4.3.13.1 Compatible Conversion

Since no additional training would be required for the compatible conversion no training costs would be incurred.

4.3.13.2 Non-Compatible Conversion

The total training costs for the non-compatible conversion is estimated to be $ 5.032 million. This estimate is based on a summation of the following cost components:

- Course Tuition - 1.583
- Covered Salary - 2.518
- Travel - 0.110
- Per Diem - 0.821

TOTAL COST - $ 5.032

The formulation and rationale for each of these components is described in the following paragraphs.

4.3.13.2.1 COURSE TUITION - $ 1.583 million

The course curriculum is based upon the actual training courses given to FAA employees in support of the Tandem MPS hardware currently installed. (Refer to Exhibit 4-1 for the list of courses, duration of the courses, and number of FAA attendees over the past five years).

It is estimated that 94 staff members will require training. This is based upon the assumption that two people from each MPS site and two from each of the nine Regional Offices will require training. It has also been assumed that:

- general concepts and overview courses will be provided to all personnel (94 engineers);
- applications development courses will be given to staff from the 5 Support MPS sites and the 9 Regional Offices (28 engineers); and
- maintenance training courses will be given only to staff from the 38 MPS sites (76 engineers).

Details of the course tuition costs are shown on Table 4-1.

May 20, 1987

Mr. A. O. Molajo
Computer Technology Associates
7927 Jones Branch Drive, Suite 600W
McLean, VA 22102

Dear Mr. Molajo;

Below you will find the list you requested outlining the number of students trained in RMMS Tandem related courses.

Course Number	Course Title	Course Length	---Fiscal Year---- 87	86	85	84	83	Total
12007	Tandem Concepts and Facilities	2 wks	59	92	49	43	78	321
12008	Fortran (no longer)	2 wks				57	65	122
12009	Tandem Software	5 wks	51	41	44	56	35	227
43495	Tandem T-16 Processor Maintenance	4 wks	28	13	37	42	26	146
43496	Tandem T-16 Disk Maintenance	2 wks	26	12	34	55	12	139
43497	Tandem T-16 Tape Drive Maintenance	1 wk	25	13	33	55	10	136
43498	COBOL-Tandem Applications	3 wks	33	33				66
43501	Maintenance Processor Subsystem (MPS) Hardware	3 wks	15	17	36	33	5	106
43521	Tandem Enform	2 wks	29	31				60
43522	Tandem Pathway	5 wks	26	34				60
43525	Tandem System Management	4 wks	29	30				59

You also requested the average salary of our students. The average salary is $36,551.

for Michael S. MacWatters
Benjamin S. MacWatters
Supervisor, Systems Course Unit, AAC-942C

EXHIBIT 4-1

TABLE 4-1

Detailed Breakdown Of Training Costs By Course and Number of Students
(38 Sites and 9 Regional Offices - 2 Students From Each For Selected Courses)

	Course Title	Number Of Students	Course Duration	Tuition Per Student	Tuition Cost Total	Burdened Salary	
*	Tandem Concepts and Facilities	94	2	$800	$75,200	$216,381	
*	Tandem Software	94	5	$2,000	$188,000	$540,952	
*	Tandem T-16 Processor Maintenance	76	4	$5,500	$418,000	$349,892	
*	Tandem T-16 Disk Maintenance	76	2	$3,000	$228,000	$174,946	
*	Tandem T-16 Tape Drive Maintenance	76	1	$1,500	$114,000	$87,473	
*	COBOL-Tandem Applications	28	3	$1,500	$42,000	$96,681	
*	NPS Hardware	94	3	$2,400	$225,600	$324,571	
*	Tandem Enform	94	2	$900	$84,600	$216,381	
*	Tandem Pathway	28	5	$2,000	$56,000	$161,135	
*	Tandem System Management	76	4	$2,000	$152,000	$349,892	Total Without Travel Costs
	TOTALS		31	$21,600	$1,583,400	$2,518,304	$4,101,704

Note:

The salary for GS 12/6 "Systems Specialists" (see Form 9, page 2-4) has been used as a representative salary level.
In addition 5% has been added to base salaries to account for "Operational Differential".
A factor of 1.5, derived from the overtime rate, has been applied to obtain the burdened salary rate.

4.3.13.2.2 COVERED SALARY - $ 2.518 million

The salary coverage costs are based upon the salary of a GS 12, step 6, ($38,000). This represents the average for the System Specialists who will attend the training. The base salary has been increased by 5% to $39,900. This is an Operational Differential paid by the FAA to its operational staff. It has been assumed that overtime will be used to cover for staff while they are in training. Reimbursement at a rate of 1.5 normal salary is paid for overtime, hence a factor of 1.5 has also been applied. This gives a burdened salary rate of $59,850.

Details of the covered salary costs are shown on Table 4-1.

4.3.13.2.3 TRAVEL COSTS - $ .110 million

In deriving the travel costs for training the following simplifying assumptions were made:

- There are forty-seven sites that require training (thirty-eight MPS sites and nine Regional offices);
- There will be seven geographically separated training centers;
- There will be approximately seven sites associated with each training center;
- The travel breakout for the seven sites per training center is:
  - Two sites will require local travel only at $50/person/site;
  - Two sites will require short distance travel at $325/person/site;
  - Three of the sites will require longer distance travel to the training location at $450/person/site;
- One round trip to home will be provided for each eight weeks of non-local training.

Based on the above assumptions, it is calculated that the round trip cost of travel for one person from each of the seven sites to go to a training center is $2,100. Therefore, the average cost per round trip is $2,100/7 or $300 per person. This $300 per person was used as the basis in determining travel cost.

4.3.13.2.4 PER DIEM - $ 0.821 million

In deriving the costs associated with per diem for training the following basic assumptions were made:

- Per diem is required for seven days/week;
- The per diem rate is $75/day/person;
- Per diem is required for 5/7 of the students attending training class (2/7 are on local travel, section 4.3.13.2.3).

Based on the above assumptions the average per diem cost per week per person is calculated as shown below:

Average Per Diem = 7days/week x $75/day/person x 5/7

= $375/week/person

4.3.14 Conversion Management and Administrative Overhead, and/or Contract Administration and Support

This task includes such activities as managing the conversion effort; supervising the technical, clerical and other managerial personnel; project management reporting which may be required; administering and supporting any contract that is let for the conversion; and technical support needed to assist in the contract administration.

For estimating purposes, the model default value of 10 percent was applied to the staff-day resources for the following tasks to calculate the effort/costs for conversion management and administrative overhead and/or contract administration and support:

- Conversion Planning and Analysis;
- Conversion Work Package Identification and Preparation;
- Test Data Generation and Validation;
- Application Program and System Software Conversion;
- Data File and Data Base Conversion;
- Operation Control Language Conversion;
- Redocumentation;
- System Testing; and
- Acceptance Testing.

4.3.14.1 Compatible Conversion

For the compatible conversion, contract administration and support costs are $7,200. This was obtained by calculating the 0.1 staff-years, generated by the model (from Table 4-2), by the FSMC recommended yearly salary default rate of $72,000.

4.3.14.2 Non-compatible Conversion

The total cost for contract administration and support for the non-compatible conversion alternative is $216,000. This cost was derived by multiplying the 3.0 staff-years, generated by the model (from Table 4-3), by the FSMC recommended yearly salary default rate of $72,000.

4.3.15 Conversion Tools and Aids

Conversion aids are developed to reduce the amount of project time and cost for a conversion. Each conversion project must be analyzed to determine if conversion aids or tools are usable and whether they will have a cost or time reduction benefit. Conversion tools are classified into six major areas: management; translation; testing; implementation; performance; and documentation. If a conversion tool(s) is usable then the costs to purchase the tool must be included in the conversion costs. If a conversion tool has to be modified, then the costs to modify the tool should be estimated and included in the conversion costs. If a conversion tool or aid must be developed, then the costs of the new development should be estimated and included in the conversion costs.

4.3.15.1 Compatible Conversion

No conversion tools or aids are required for the compatible conversion, therefore, no costs would be incurred.

4.3.15.2 Non-compatible Conversion

The total costs for conversion tools or aids for the non-compatible conversion is zero. No conversion tools or aids were considered viable for the software conversion because: the software either transported directly; required a total rewrite because it was a Tandem specific product; or made significant calls to Tandem utilities and extensions along with requiring major program logic modifications; therefore, not readily lending itself to automatic translators.

4.4 CONVERSION SCHEDULE AND STAFFING ESTIMATES

In addition to estimating effort (staff-years) and cost for the compatible and non-compatible conversion alternatives, the Conversion Cost Model was used to estimate schedule (duration in months) and staffing levels for the non-compatible conversion alternative.

The model utilizes the effort calculated for the non-compatible conversion and will either estimate project duration or the required average staffing level depending on whether duration or the average staffing level was used as the input. Using a labor effort requirement of 33.4 staff years, calculated from the model, for the non-compatible conversion the following schedule scenarios were run:

- A duration of 30 months, as calculated by the COCOMO Model (from the MPS Hardware Upgrade Trade Study), was used as the model input with staffing levels being estimated by the model. This represents the optimum conversion schedule;

- Durations of four, six, eight, and twelve months were used as model inputs with staffing levels for each being estimated by the model; and

- An average staffing level of 30 staff members was used as the model input with duration being estimated by the model.

The results of each of these model runs can be found in Figures 4-3 through 4-8 and are summarized in Section 5.1.2.2, Non-compatible Conversion Alternative Risks.

COST MODEL INPUT DATA FOR PROJECT mms compat baseline 000

```
1.  Project No. (1-25 characters)==================>mms compat baseline 000
2.  Compatible or Noncompatible? (C or N) ==========>c
3.  No. of Systems (1-999)=========================>7
4.  No. of Programs (1-99999)======================>436
5.  No. of Files and Data Bases (1-99999)==========>0
6.  No. of Files/Data Bases Class A ================>0
7.  No. of Files/Data Bases Class B ================>0
8.  No. of Files/Data Bases Class C ================>0
9.  No. of Files/Data Bases Class D ================>0
10. No. of Files/Data Bases Class E ================>0
11. No. of Job Streams/Independent Runs (1-99999)==========>80
12. % of Available/Up-to-date Documentation (0-1.00)=======>0
13. % Logic Paths Executed Existing Test Data (0-1.00)=====>0
14. % Logic Paths Required to be Executed (0-1.00)=========>0
15. No. of Days Duration for Acceptance Testing (1-360)====>0
16. No. of Probable Reruns for Systems Testings (0-10)=====>0
17. % Conversion Management & Contract Support (0-.30)=====>.1
18. % of Coordination Required for Documentation (0-.30)===>0
19. Salary Task A. Conv Planning/Analysis (0-100000)=======>72000
20. Salary Task C. Work Package Id & Prep (0-100000)=======>0
21. Salary Task D. Test Data Set Gen/Valid (0-100000)======>0
22. Salary Task E. Application Program Conv (0-100000)=====>0
23. Salary Task F. Data File/Data Base Conv (0-100000)=====>0
24. Salary Task G. OCL Conversion (0-100000)==============>0
25. Salary Task H. Redocumentation (0-100000)=============>0
26. Salary Task I. System Testing (0-100000)==============>0
27. Salary Task J. Acceptance Testing (0-100000)==========>0
28. Salary Task N. Conv Mgmt/Admin/Cont Supt (0-100000)===>72000
29. Machine Use % Task A. Conv Plan/Analysis (0-.50)=======>.1
30. Machine Use % Task C. WP Id & Prep (0-.50)============>0
31. Machine Use % Task D. TD Set Gen/Valid (0-.50)========>0
32. Machine Use % Task E. Application Conv (0-.50)========>0
33. Machine Use % Task F. DF/DB Conv (0-.50)==============>0
34. Machine Use % Task G. OCL Conv (0-.50)================>0
35. Machine Use % Task I. System Test (0-.50)=============>0
36. Machine Use % Task J. Accept Test (0-.50)=============>0
37. Other Costs Task A. Conv Plan/Analysis (0-9999999)====>0
38. Other Costs Task B. Invent & Study (0-9999999)========>67400
39. Other Costs Task C. WP ID/Prep (0-9999999)============>0
40. Other Costs Task D. TD Gen/Valid (0-9999999)==========>0
41. Other Costs Task E. Application Conv (0-9999999)======>0
42. Other Costs Task F. File/Data Base Conv (0-9999999)===>0
43. Other Costs Task G. OCL Conv (0-9999999)==============>0
44. Other Costs Task H. Redocumentation (0-9999999)=======>0
45. Other Costs Task I. System Testing (0-9999999)========>0
46. Other Costs Task J. Acceptance Testing (0-9999999)====>0
47. Other Costs Task K. Site Preparation (0-9999999)======>133000
48. Other Costs Task L. System Transition (0-9999999)=====>0
49. Other Costs Task M. Conv Training (0-9999999)=========>0
50. Other Costs Task N. Mgmt/Cont Supt (0-9999999)========>0
51. Other Costs Task O. Conv Tools/Aids (0-9999999)=======>0
52. Baseline New Dev Rate DDL (10-100 (60 standard))======>0
```

FIGURE 4-1

COST MODEL INPUT DATA FOR PROJECT mms compat baseline 000

53. Lines of Code Class 1 (0-9999999)==========>0
54. Automated Translation % Class 1 (0-1.00)==========>0
55. Lines of Code Class 2 (0-9999999)==========>0
56. Automated Translation % Class 2 (0-1.00)==========>0
57. Lines of Code Class 3 (0-9999999)==========>0
58. Automated Translation % Class 3 (0-1.00)==========>0
59. Lines of Code Class 4 (0-9999999)==========>0
60. Automated Translation % Class 4 (0-1.00)==========>0
61. Lines of Code Class 5 (0-9999999)==========>0
62. Baseline New Dev Rate DCL/JCL (10-100 (60 standard))=>0
63. Lines of Code Class 1 (0-9999999)==========>0
64. Automated Translation % Class 1 (0-1.00)==========>0
65. Lines of Code Class 2 (0-9999999)==========>0
66. Automated Translation % Class 2 (0-1.00)==========>0
67. Lines of Code Class 3 (0-9999999)==========>0
68. Automated Translation % Class 3 (0-1.00)==========>0
69. Lines of Code Class 4 (0-9999999)==========>0
70. Automated Translation % Class 4 (0-1.00)==========>0
71. Lines of Code Class 5 (0-9999999)==========>0
72. Maximum No. of Source/Target Language Pairs (1-5)===>0
73. Source/Target Language Desc (1-15 characters)=======>
74. Baseline New Dev Rate per Language (10-100)========>0
75. Lines of Code Class 1 (0-9999999)==========>0
76. Automated Translation % Class 1 (0-1.00)==========>0
77. Lines of Code Class 2 (0-9999999)==========>0
78. Automated Translation % Class 2 (0-1.00)==========>0
79. Lines of Code Class 3 (0-9999999)==========>0
80. Automated Translation % Class 3 (0-1.00)==========>0
81. Lines of Code Class 4 (0-9999999)==========>0
82. Automated Translation % Class 4 (0-1.00)==========>0
83. Lines of Code Class 5 (0-9999999)==========>0
84. Source/Target Language Desc (1-15 characters)=======>
85. Baseline New Dev Rate per Language (10-100)========>0
86. Lines of Code Class 1 (0-9999999)==========>0
87. Automated Translation % Class 1 (0-1.00)==========>0
88. Lines of Code Class 2 (0-9999999)==========>0
89. Automated Translation % Class 2 (0-1.00)==========>0
90. Lines of Code Class 3 (0-9999999)==========>0
91. Automated Translation % Class 3 (0-1.00)==========>0
92. Lines of Code Class 4 (0-9999999)==========>0
93. Automated Translation % Class 4 (0-1.00)==========>0
94. Lines of Code Class 5 (0-9999999)==========>0
95. Source/Target Language Desc (1-15 characters)=======>
96. Baseline New Dev Rate per Language (10-100)========>0
97. Lines of Code Class 1 (0-9999999)==========>0
98. Automated Translation % Class 1 (0-1.00)==========>0
99. Lines of Code Class 2 (0-9999999)==========>0
100. Automated Translation % Class 2 (0-1.00)==========>0
101. Lines of Code Class 3 (0-9999999)==========>0
102. Automated Translation % Class 3 (0-1.00)==========>0
103. Lines of Code Class 4 (0-9999999)==========>0
104. Automated Translation % Class 4 (0-1.00)==========>0

FIGURE 4-1 CONTINUED

105. Lines of Code Class 5 (0-9999999)==========>0
106. Source/Target Language Desc (1-15 characters)==========>
107. Baseline New Dev Rate per Language (10-100)==========>0
108. Lines of Code Class 1 (0-9999999)==========>0
109. Automated Translation % Class 1 (0-1.00)==========>0
110. Lines of Code Class 2 (0-9999999)==========>0
111. Automated Translation % Class 2 (0-1.00)==========>0
112. Lines of Code Class 3 (0-9999999)==========>0
113. Automated Translation % Class 3 (0-1.00)==========>0
114. Lines of Code Class 4 (0-9999999)==========>0
115. Automated Translation % Class 4 (0-1.00)==========>0
116. Lines of Code Class 5 (0-9999999)==========>0
117. Source/Target Language Desc (1-15 characters)==========>
118. Baseline New Dev Rate per Language (10-100)==========>0
119. Lines of Code Class 1 (0-9999999)==========>0
120. Automated Translation % Class 1 (0-1.00)==========>0
121. Lines of Code Class 2 (0-9999999)==========>0
122. Automated Translation % Class 2 (0-1.00)==========>0
123. Lines of Code Class 3 (0-9999999)==========>0
124. Automated Translation % Class 3 (0-1.00)==========>0
125. Lines of Code Class 4 (0-9999999)==========>0
126. Automated Translation % Class 4 (0-1.00)==========>0
127. Lines of Code Class 5 (0-9999999)==========>0

FILE: b:compbase.dat

FIGURE 4-1 CONTINUED

```
*********************************************************************************
*   CONVERSION COST MODEL (VERSION 4) FOR PROJECT  mms compat baseline 000     *
*   01-01-1980   00:06:33   ALGORITHMS USED FOR CONVERSION RESOURCE ESTIMATING*
*********************************************************************************

TASK A. SD=(( 1 *S) + ( .5 *P) + ( .5 *J))
TASK C. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK D. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK E. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK F. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK G. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK H. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK I. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK J. NOT APPLICABLE TO COMPATIBLE CONVERSION
TASK N. SD=(TOTAL SD FOR TASKS A THRU J) * MCS

*********************************************************************************


*********************************************************************************
*   CONVERSION COST MODEL (VERSION 4) FOR PROJECT  mms compat baseline 000     *
*   01-01-1980   00:06:39       COMPATIBLE CONVERSION                          *
*********************************************************************************
```

CONVERSION TASK	STAFF-YRS	RATE ($000)	STAFF-COST ($000)	M%	MACH-COST ($000)	MISC-COST ($000)	TOT-COST ($000)
A. PLAN/ANALYSIS	1.1	72.0	79.2	10.0	7.9	0.0	87.1
B. INVENT/STUDY	0.0	0.0	0.0	0.0	0.0	67.4	67.4
C. WP IDENT/PREP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D. TD GENR/VALID	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E. SOFTWARE CONV	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F. DF/DB CONV	0.0	0.0	0.0	0.0	0.0	0.0	0.0
G. DCL CONV	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H. REDOCUMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I. SYSTEM TEST	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J. ACCEPT TEST	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K. SITE PREP	0.0	0.0	0.0	0.0	0.0	133.0	133.0
L. SYSTEM TRANS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M. CONV TRAINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N. MGMT/CONT SUPT	0.1	72.0	7.2	0.0	0.0	0.0	7.2
O. TOOLS/AIDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS	1.2		86.4		7.9	200.4	294.7

```
*********************************************************************************

COST MODEL INPUT DATA FOR THIS RUN IN FILE              b:compbase.dat

*********************************************************************************
```

25

TABLE 4-2

COST MODEL INPUT DATA FOR PROJECT mms non compat baseline

1. Project No. (1-25 characters)==========>mms non compat baseline
2. Compatible or Noncompatible? (C or N) ==========>n
3. No. of Systems (1-999)==========>7
4. No. of Programs (1-99999)==========>436
5. No. of Files and Data Bases (1-99999)==========>36
6. No. of Files/Data Bases Class A ==========>36
7. No. of Files/Data Bases Class B ==========>0
8. No. of Files/Data Bases Class C ==========>0
9. No. of Files/Data Bases Class D ==========>0
10. No. of Files/Data Bases Class E ==========>0
11. No. of Job Streams/Independent Runs (1-99999)==========>80
12. % of Available/Up-to-date Documentation (0-1.00)==========>.88
13. % Logic Paths Executed Existing Test Data (0-1.00)==========>.74
14. % Logic Paths Required to be Executed (0-1.00)==========>.775
15. No. of Days Duration for Acceptance Testing (1-360)==>90
16. No. of Probable Reruns for Systems Testings (0-10)==>5
17. % Conversion Management & Contract Support (0-.30)==>.1
18. % of Coordination Required for Documentation (0-.30)=>.1
19. Salary Task A. Conv Planning/Analysis (0-100000)==========>72000
20. Salary Task C. Work Package Id & Prep (0-100000)==========>72000
21. Salary Task D. Test Data Set Gen/Valid (0-100000)==========>72000
22. Salary Task E. Application Program Conv (0-100000)==========>72000
23. Salary Task F. Data File/Data Base Conv (0-100000)==========>72000
24. Salary Task G. OCL Conversion (0-100000)==========>72000
25. Salary Task H. Redocumentation (0-100000)==========>72000
26. Salary Task I. System Testing (0-100000)==========>72000
27. Salary Task J. Acceptance Testing (0-100000)==========>72000
28. Salary Task N. Conv Mgmt/Admin/Cont Supt (0-100000)==>72000
29. Machine Use % Task A. Conv Plan/Analysis (0-.50)==========>.1
30. Machine Use % Task C. WP Id & Prep (0-.50)==========>.1
31. Machine Use % Task D. TD Set Gen/Valid (0-.50)==========>.1
32. Machine Use % Task E. Application Conv (0-.50)==========>.1
33. Machine Use % Task F. DF/DB Conv (0-.50)==========>.1
34. Machine Use % Task G. OCL Conv (0-.50)==========>.1
35. Machine Use % Task I. System Test (0-.50)==========>.1
36. Machine Use % Task J. Accept Test (0-.50)==========>.1
37. Other Costs Task A. Conv Plan/Analysis (0-9999999)==========>0
38. Other Costs Task B. Invent & Study (0-9999999)==========>67400
39. Other Costs Task C. WP ID/Prep (0-9999999)==========>0
40. Other Costs Task D. TD Gen/Valid (0-9999999)==========>0
41. Other Costs Task E. Application Conv (0-9999999)==========>0
42. Other Costs Task F. File/Data Base Conv (0-9999999)==========>0
43. Other Costs Task G. OCL Conv (0-9999999)==========>0
44. Other Costs Task H. Redocumentation (0-9999999)==========>0
45. Other Costs Task I. System Testing (0-9999999)==========>0
46. Other Costs Task J. Acceptance Testing (0-9999999)==========>0
47. Other Costs Task K. Site Preparation (0-9999999)==========>410210
48. Other Costs Task L. System Transition (0-9999999)==========>58200
49. Other Costs Task M. Conv Training (0-9999999)==========>5032000
50. Other Costs Task N. Mgmt/Cont Supt (0-9999999)==========>0
51. Other Costs Task O. Conv Tools/Aids (0-9999999)==========>0
52. Baseline New Dev Rate DDL (10-100 (60 standard))==========>60

FIGURE 4-2

COST MODEL INPUT DATA FOR PROJECT mms non compat baseline

```
53.  Lines of Code Class 1 (0-9999999)==================>19567
54.  Automated Translation % Class 1 (0-1.00)============>0
55.  Lines of Code Class 2 (0-9999999)==================>0
56.  Automated Translation % Class 2 (0-1.00)============>0
57.  Lines of Code Class 3 (0-9999999)==================>0
58.  Automated Translation % Class 3 (0-1.00)============>0
59.  Lines of Code Class 4 (0-9999999)==================>0
60.  Automated Translation % Class 4 (0-1.00)============>0
61.  Lines of Code Class 5 (0-9999999)==================>0
62.  Baseline New Dev Rate OCL/JCL (10-100 (60 standard))=>60
63.  Lines of Code Class 1 (0-9999999)==================>1585
64.  Automated Translation % Class 1 (0-1.00)============>0
65.  Lines of Code Class 2 (0-9999999)==================>0
66.  Automated Translation % Class 2 (0-1.00)============>0
67.  Lines of Code Class 3 (0-9999999)==================>0
68.  Automated Translation % Class 3 (0-1.00)============>0
69.  Lines of Code Class 4 (0-9999999)==================>0
70.  Automated Translation % Class 4 (0-1.00)============>0
71.  Lines of Code Class 5 (0-9999999)==================>0
72.  Maximum No. of Source/Target Language Pairs (1-5)====>3
73.  Source/Target Language Desc (1-15 characters)========>scobol
74.  Baseline New Dev Rate per Language (10-100)==========>30
75.  Lines of Code Class 1 (0-9999999)==================>214659
76.  Automated Translation % Class 1 (0-1.00)============>0
77.  Lines of Code Class 2 (0-9999999)==================>0
78.  Automated Translation % Class 2 (0-1.00)============>0
79.  Lines of Code Class 3 (0-9999999)==================>0
80.  Automated Translation % Class 3 (0-1.00)============>0
81.  Lines of Code Class 4 (0-9999999)==================>0
82.  Automated Translation % Class 4 (0-1.00)============>0
83.  Lines of Code Class 5 (0-9999999)==================>0
84.  Source/Target Language Desc (1-15 characters)========>cobol
85.  Baseline New Dev Rate per Language (10-100)==========>30
86.  Lines of Code Class 1 (0-9999999)==================>0
87.  Automated Translation % Class 1 (0-1.00)============>0
88.  Lines of Code Class 2 (0-9999999)==================>28520
89.  Automated Translation % Class 2 (0-1.00)============>0
90.  Lines of Code Class 3 (0-9999999)==================>0
91.  Automated Translation % Class 3 (0-1.00)============>0
92.  Lines of Code Class 4 (0-9999999)==================>0
93.  Automated Translation % Class 4 (0-1.00)============>0
94.  Lines of Code Class 5 (0-9999999)==================>71732
95.  Source/Target Language Desc (1-15 characters)========>tal
96.  Baseline New Dev Rate per Language (10-100)==========>20
97.  Lines of Code Class 1 (0-9999999)==================>1392
98.  Automated Translation % Class 1 (0-1.00)============>0
99.  Lines of Code Class 2 (0-9999999)==================>0
100  Automated Translation % Class 2 (0-1.00)============>0
101  Lines of Code Class 3 (0-9999999)==================>0
102  Automated Translation % Class 3 (0-1.00)============>0
103  Lines of Code Class 4 (0-9999999)==================>0
104  Automated Translation % Class 4 (0-1.00)============>0
```

FIGURE 4-2 CONTINUED

COST MODEL INPUT DATA FOR PROJECT mms non compat baseline

```
105. Lines of Code Class 5 (0-9999999)==================>0
106. Source/Target Language Desc (1-15 characters)=======>-----
107. Baseline New Dev Rate per Language (10-100)=========>10
108. Lines of Code Class 1 (0-9999999)==================>0
109. Automated Translation % Class 1 (0-1.00)============>0
110. Lines of Code Class 2 (0-9999999)==================>0
111. Automated Translation % Class 2 (0-1.00)============>0
112. Lines of Code Class 3 (0-9999999)==================>0
113. Automated Translation % Class 3 (0-1.00)============>0
114. Lines of Code Class 4 (0-9999999)==================>0
115. Automated Translation % Class 4 (0-1.00)============>0
116. Lines of Code Class 5 (0-9999999)==================>0
117. Source/Target Language Desc (1-15 characters)=======>
118. Baseline New Dev Rate per Language (10-100)=========>0
119. Lines of Code Class 1 (0-9999999)==================>0
120. Automated Translation % Class 1 (0-1.00)============>0
121. Lines of Code Class 2 (0-9999999)==================>0
122. Automated Translation % Class 2 (0-1.00)============>0
123. Lines of Code Class 3 (0-9999999)==================>0
124. Automated Translation % Class 3 (0-1.00)============>0
125. Lines of Code Class 4 (0-9999999)==================>0
126. Automated Translation % Class 4 (0-1.00)============>0
127. Lines of Code Class 5 (0-9999999)==================>0
```

FILE: b:diffbase.dat

FIGURE 4-2 CONTINUED

```
*****************************************************************************
*   CONVERSION COST MODEL (VERSION 4) FOR PROJECT  mms non compat baseline  *
*   06-26-1987   15:20:22   ALGORITHMS USED FOR CONVERSION RESOURCE ESTIMATING*
*****************************************************************************

TASK A. SD=(( 5 *S) + ( 1 *P) + ( 1 *J))
TASK C. SD=( 3 *S) + ((P+F+J)/ 10 )
TASK D. SD=(( 2 *P) + ( 1 *F)) * (.2+(TDR-TDE)) * (1-(DOC/3))
TASK E. MCPRs=(BR*NDE)/(((1-(DOC/2))*DEs)+PEs+TEs)
        SDs=((LOCs * (1-Ts))/MCPRs) + ((LOCs * Ts)/ 1000 )
        SD=SUM OF SDs (where s=1-5)
TASK F. MCPRs=(BR*NDE)/(((1-(DOC/2))*DEs)+PEs+TEs)
        SDs=((DDLs * (1-Ts))/MCPRs) + ((DDLs * Ts)/ 1000 )
        SDf=(Ff * FCFf) * (1-(DOC/2))
        SD=SUM of SDs (where s=1-5) and SDf (where f=A-E)
TASK G. MCPRs=(BR*NDE)/(((1-(DOC/2))*DEs)+PEs+TEs)
        SDs=((OCLs * (1-Ts))/MCPRs) + ((OCLs * Ts)/ 1000 )
        SD=SUM OF SDs (where s=1-5)
TASK H. SD=(( .75 *P) + ( 3 *S)) * (1+RCOR) * DOC
TASK I. SD=((J/ 4 )+(P/ 2 )+(S/ 2 )+((P+F+J)/ 80 ))*(1+(RE/10))
TASK J. SD=((DUR*(S/ 8 ))+((( 1 *J) + ((P+F)/ 5 ))*(1-e**-(DUR/20))))
TASK N. SD=(TOTAL SD FOR TASKS A THRU J) * MCS

*****************************************************************************
```

```
*****************************************************************************
*   CONVERSION COST MODEL (VERSION 4) FOR PROJECT  mms non compat baseline  *
*   06-26-1987   15:20:29   NONCOMPATIBLE CONVERSION                        *
*****************************************************************************
```

CONVERSION TASK	STAFF-YRS	RATE (000$)	STAFF-COST (000$)	M%	MACH-COST (000$)	MISC-COST (000$)	TOT-COST (000$)
A. PLAN/ANALYSIS	2.3	72.0	165.6	10.0	16.6	0.0	182.2
B. INVENT/STUDY	0.0	0.0	0.0	0.0	0.0	67.4	67.4
C. WP IDENT/PREP	0.3	72.0	21.6	10.0	2.2	0.0	23.8
D. TD GENR/VALID	0.6	72.0	43.2	10.0	4.3	0.0	47.5
E. SOFTWARE CONV	21.8	72.0	1569.6	10.0	157.0	0.0	1726.6
F. DF/DB CONV	1.3	72.0	93.6	10.0	9.4	0.0	103.0
G. OCL CONV	0.1	72.0	7.2	10.0	0.7	0.0	7.9
H. REDOCUMENT	1.4	72.0	100.8	0.0	0.0	0.0	100.8
I. SYSTEM TEST	1.6	72.0	115.2	10.0	11.5	0.0	126.7
J. ACCEPT TEST	1.0	72.0	72.0	10.0	7.2	0.0	79.2
K. SITE PREP	0.0	0.0	0.0	0.0	0.0	410.2	410.2
L. SYSTEM TRANS	0.0	0.0	0.0	0.0	0.0	58.3	58.3
M. CONV TRAINING	0.0	0.0	0.0	0.0	0.0	5032.0	5032.0
N. MGMT/CONT SUPT	3.0	72.0	216.0	0.0	0.0	0.0	216.0
O. TOOLS/AIDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS	33.4		2404.8		208.9	5567.9	8181.6

```
*****************************************************************************

COST MODEL INPUT DATA FOR THIS RUN IN FILE              b:diffbase.dat

*****************************************************************************
```

TABLE 4-3

```
ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ======>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) =======> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) ======> 4

  STAFFING LEVEL WILL BE  133.6  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? ======> n
```

FIGURE 4-3

TASK SCHEDULE
PROJECT NO. xxx non compat baseline
(EACH COLUMN = 1 MONTH)

MONTH	5
A PLAN/ANALYSIS	X
B INVENT/STUDY	X
C UP IDENT/PREP	X
D TO GENR/VALID	X
E SOFTWARE CONV	XXX
F DF/DD CONV	XXX
G DCL CONV	XXX
H REDOCUMENT	XXX
I SYSTEM TEST	XX
J ACCEPT TEST	X
K SITE PREP	X
L SYSTEM TRANS	XX
M CONV TRAINING	X
N MAINT/CONFT SPT	XXXX
O TOOLS/AIDS	

FIGURE 4-3 CONTINUED

STAFFING SCHEDULE
PROJECT NO. mms man carpet baseline

MONTH	1	2	3	4
A PLAN/ANALYSIS	27.6			
B INVENT/STUDY				
C HP IDENT/PREP	3.6			
D TD GENR/VALID	7.2			
E SOFTWARE CONV	21.0	112.4	128.1	
F DP/DB CONV	1.3	6.7	7.6	
G DCL CONV	0.1	0.5	0.6	
H REDOCUMENT		2.0	7.4	7.4
I SYSTEM TEST			9.6	9.6
J ACCEPT TEST				12.0
K SITE PREP				
L SYSTEM TRANS				
M CONV TRAINING				
N MGMT/CONT RPT	6.0	12.0	12.0	6.0
O TOOLS/AIDS				
.....	.....	.....	.....	.....
SUBTOTALS	66.8	133.6	165.4	35.0

FIGURE 4-3 CONTINUED

RESOURCE SCHEDULE
PROJECT NO. mms non compat baseline
PAGE 1

MONTH	1	2	3	4
A PLAN/ANALYSIS				
STAFF COST	165.6			
MACH COST	16.6			
B INVENT/STUDY				
MISC COST	67.4			
C WP IDENT/PREP				
STAFF COST	21.6			
MACH COST	2.2			
D TD GENR/VALID				
STAFF COST	43.2			
MACH COST	4.3			
E SOFTWARE CONV				
STAFF COST	126.3	674.5	768.8	
MACH COST	52.3	52.3	52.3	
F DF/DB CONV				
STAFF COST	7.5	40.2	45.8	
MACH COST	3.1	3.1	3.1	
G OCL CONV				
STAFF COST	0.6	3.1	3.5	
MACH COST	0.2	0.2	0.2	
H REDOCUMENT				
STAFF COST		11.8	44.5	44.5
I SYSTEM TEST				
STAFF COST			57.6	57.6
MACH COST			5.8	5.8
J ACCEPT TEST				
STAFF COST				72.0
MACH COST				7.2
K SITE PREP				
MISC COST	410.2			
L SYSTEM TRANS				
MISC COST	29.1	29.1		
M CONV TRAINING				
MISC COST				5032.0
N MAINT/CONT SPT				
STAFF COST	36.0	72.0	72.0	36.0
O TOOLS/AIDS				
---	---	---	---	---
SUBTOTALS				
STAFF COST	400.8	801.6	992.3	210.1
MACH COST	78.8	55.7	61.5	12.9
MISC COST	506.8	29.1		5032.0
TOTAL MONTH	986.4	886.4	1053.7	5255.1

FILE: b:diffbase.SCH

FIGURE 4-3 CONTINUED

```
                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ======>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) =======> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) ======> 6

  STAFFING LEVEL WILL BE  100.2  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? ======> n
```


```
                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ======>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) =======> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) =======> 6

  STAFFING LEVEL WILL BE  100.2  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? =======> n
```


```
       (PERFORMING INITIAL COMPUTATIONS)
LINE 2630

A>
```

MODEL FAILS WITH A SIX MONTH SCHEDULE

6.01 MONTHS WILL RUN

(next page)

FIGURE 4-4

```
                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ======>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) =======> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) ======> 6.01

  STAFFING LEVEL WILL BE  100  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? ======> n
```

FIGURE 4-4 CONTINUED

TASK SCHEDULE
PROJECT NO. Wms non comput baseline
(EACH COLUMN = 1 MONTH)

```
     MONTH          5   10
                    '   '
A PLAN/ANALYSIS   XX
B INVENT/STUDY    XX
C WP IDENT/PREP   XXX
D TD GENR/VALID   XXX
E SOFTWARE CONV    XXXXX
F DF/DB CONV       XXXXX
G OCL CONV         XXXXX
H REDOCUMENT        XXX
I SYSTEM TEST        X
J ACCEPT TEST         X
K SITE PREP       XX
L SYSTEM TRAIN     XXX
M CONV TRAINING       X
N MAINT/CONT SPT  XXXXXXX
O TOOLS/AIDS
```

FIGURE 4-4 CONTINUED

STAFFING SCHEDULE
PROJECT NO. mms non compat baseline

MONTH	1	2	3	4	5	6
A PLAN/ANALYSIS	7.1	20.5				
B INVENT/STUDY						
C MP IDENT/PREP	0.2	3.0	0.4			
D TD GENR/VALID	0.3	6.1	0.8			
E SOFTWARE CONV		22.2	70.3	70.7	69.1	29.3
F DF/DS CONV		1.3	4.2	4.2	4.1	1.7
G DCL CONV		0.1	0.3	0.3	0.3	0.1
H REDOCUMENT				0.8	2.4	13.6
I SYSTEM TEST						19.2
J ACCEPT TEST						
K SITE PREP						
L SYSTEM TRANS						
M CONV TRAINING						
N MGMT/CONT SPT	0.8	5.2	7.5	7.5	7.5	7.5
O TOOLS/AIDS						
SUBTOTALS	8.4	58.4	83.5	83.5	83.5	71.5

FIGURE 4-4 CONTINUED

RESOURCE SCHEDULE

PROJECT NO. mms non compat baseline

PAGE 1

MONTH	1	2	3	4	5	6
A PLAN/ANALYSIS						
STAFF COST	42.8	122.8				
MACH COST	8.3	8.3				
B INVENT/STUDY						
MISC COST	33.7	33.7				
C UP IDENT/PREP						
STAFF COST	0.9	18.2	2.5			
MACH COST	0.7	0.7	0.7			
D TD GENR/VALID						
STAFF COST	1.9	36.4	4.9			
MACH COST	1.4	1.4	1.4			
E SOFTWARE CONV						
STAFF COST		133.2	421.6	424.2	414.9	175.8
MACH COST		31.4	31.4	31.4	31.4	31.4
F DF/DB CONV						
STAFF COST		7.9	25.1	25.3	24.7	10.5
MACH COST		1.9	1.9	1.9	1.9	1.9
G OCL CONV						
STAFF COST		0.6	1.9	1.9	1.9	0.8
MACH COST		0.1	0.1	0.1	0.1	0.1
H REDOCUMENT						
STAFF COST				4.6	14.5	81.7
I SYSTEM TEST						
STAFF COST						115.2
MACH COST						11.5
J ACCEPT TEST						
STAFF COST						
MACH COST						
K SITE PREP						
MISC COST	205.1	205.1				
L SYSTEM TRANS						
MISC COST			19.4	19.4	19.4	
M CONV TRAINING						
MISC COST						
N MAINT/CONT SPT						
STAFF COST	4.8	31.2	45.0	45.0	45.0	45.0
O TOOLS/AIDS						
.....	.....	.....	.....	.....	.....	.....
SUBTOTALS						
STAFF COST	50.4	350.4	501.0	501.0	501.0	429.0
MACH COST	10.5	43.9	35.6	33.6	33.6	44.9
MISC COST	238.8	238.8	19.4	19.4	19.4	
TOTAL MONTH	299.7	633.1	556.0	553.9	553.9	473.9

FILE: b:diffbase.SCH

FIGURE 4-4 CONTINUED

```
                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) =======>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) ========> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) =======> 8

  STAFFING LEVEL WILL BE  66.8  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? =======> n
```

FIGURE 4-5

TASK SCHEDULE

PROJECT NO. one non compat baseline

(EACH COLUMN = 1 MONTH)

MONTH	5	10
A PLAN/ANALYSIS	XX	
B INVENT/STUDY	X	
C UP IDENT/PREP	XXXX	
D TD GENR/VALID	XXXX	
E SOFTWARE CONV	XXXXXX	
F DF/DB CONV	XXXXXX	
G OCL CONV	XXXXXX	
H REDOCUMENT	XXXX	
I SYSTEM TEST	XX	
J ACCEPT TEST	X	
K SITE PREP	X	
L SYSTEM TRANS	XXXXX	
M CONV TRAINING	X	
N MAINT/CONT SPT	XXXXXXXX	
O TOOLS/AIDS		

FIGURE 4-5 CONTINUED

STAFFING SCHEDULE
PROJECT NO. one man compat baseline

MONTH	1	2	3	4	5	6	7	8
A PLAN/ANALYSIS	14.3	13.3						
B INVEST/STUDY								
C HP IDENT/PREP	0.3	1.1	1.8	0.4				
D TO GENR/VALID	0.6	2.3	3.5	0.8				
E SOFTWARE CONV		27.1	52.1	96.8	53.5	34.3	10.6	
F DP/DD CONV		1.7	3.1	3.3	3.2	3.2	1.1	
G DCL CONV		0.2	0.3	0.3	0.2	0.2	0.1	
H REDOCUMENT					3.9	3.1	8.7	1.1
I SYSTEM TEST							17.1	2.1
J ACCEPT TEST								12.8
K SITE PREP								
L SYSTEM TRANS								
M CONV TRAINING								
N MGMT/CONT SPT	1.5	4.5	6.0	6.0	6.0	6.0	4.5	1.5
O TOOLS/AIDS								
SUBTOTALS	16.7	50.1	66.8	66.8	66.8	66.8	50.1	16.7

FIGURE 4-5 CONTINUED

RESOURCE SCHEDULE
PROJECT NO. mms non compat baseline
PAGE 1

MONTH	1	2	3	4	5	6	7	8
A PLAN/ANALYSIS								
STAFF COST	85.6	80.0						
MACH COST	8.3	8.3						
B INVENT/STUDY								
MISC COST	67.4							
C UP IDENT/PREP								
STAFF COST	1.9	6.8	10.5	2.5				
MACH COST	0.6	0.6	0.6	0.6				
D TD GENR/VALID								
STAFF COST	3.7	13.6	21.0	4.9				
MACH COST	1.1	1.1	1.1	1.1				
E SOFTWARE CONV								
STAFF COST		162.4	312.8	335.8	320.9	326.0	111.7	
MACH COST		26.2	26.2	26.2	26.2	26.2	26.2	
F DF/DB CONV								
STAFF COST		9.9	18.7	20.0	19.0	19.3	6.6	
MACH COST		1.6	1.6	1.6	1.6	1.6	1.6	
G OCL CONV								
STAFF COST		0.9	1.8	1.7	1.3	1.1	0.4	
MACH COST		0.1	0.1	0.1	0.1	0.1	0.1	
H REDOCUMENT								
STAFF COST					23.6	18.3	52.4	6.5
I SYSTEM TEST								
STAFF COST							102.5	12.7
MACH COST							5.8	5.8
J ACCEPT TEST								
STAFF COST								72.0
MACH COST								7.2
K SITE PREP								
MISC COST	410.2							
L SYSTEM TRANS								
MISC COST		11.7	11.7	11.7	11.7	11.7		
M CONV TRAINING								
MISC COST								5032.0
N MGMT/CONT SPT								
STAFF COST	9.0	27.0	36.0	36.0	36.0	36.0	27.0	9.0
O TOOLS/AIDS								
---	---	---	---	---	---	---	---	---
SUBTOTALS								
STAFF COST	100.2	300.6	400.8	400.8	400.8	400.8	300.6	100.2
MACH COST	9.9	37.8	29.5	29.5	27.9	27.9	33.6	12.9
MISC COST	477.6	11.7	11.7	11.7	11.7	11.7		5032.0
TOTAL MONTH	587.7	350.0	441.9	441.9	440.3	440.3	334.2	5145.1

FILE: b:diffbase.SCH

FIGURE 4-5 CONTINUED

```
                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ------>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) -------> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) ------> 12

  STAFFING LEVEL WILL BE  44.5  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? ------> n
```

FIGURE 4-6

TASK SCHEDULE
PROJECT NO. xxxx ram compat baseline
(EACH COLUMN = 1 MONTH)

MONTH	5	10	15
A PLAN/ANALYSIS	XX		
B INVENT/STUDY	XXX		
C HP IDENT/PREP	XXXX		
D TD GENR/VALID	XXXX		
E SOFTWARE CONV	XXXXXXXX		
F DF/DS CONV	XXXXXXXX		
G OCL CONV	XXXXXXX		
H REDOCUMENT	XXXXX		
I SYSTEM TEST	XX		
J ACCEPT TEST	XX		
K SITE PREP	XXX		
L SYSTEM TRANS	XXXXXXX		
M CONV TRAINING	X		
N MAINT/CONT SPT	XXXXXXXXXXXX		
O TOOLS/AIDS			

FIGURE 4-6 CONTINUED

STAFFING SCHEDULE

PROJECT NO. [illegible] baseline

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
A PLAN/ANALYSIS	10.2	17.4										
B INVENT/STUDY												
C WP IDENT/PREP		1.0	1.6	0.7	0.3							
D TD GENR/VALID		2.0	3.1	1.5	0.6							
E SOFTWARE CONV			24.3	36.0	37.1	38.1	35.7	34.4	35.6	20.4		
F DF/DB CONV			1.5	2.2	2.2	2.2	2.1	2.0	2.1	1.2		
G JCL CONV				0.1	0.2	0.2	0.2	0.2	0.2	0.1		
H REDOCUMENT							2.5	3.8	2.7	3.1	4.7	
I SYSTEM TEST										5.6	13.6	
J ACCEPT TEST											1.9	10.1
K SITE PREP												
L SYSTEM TRAIN												
M CONV TRAINING												
N MGMT/CONT SPT	1.0	2.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.0	1.0
O TOOLS/AIDS												
....	....	....	....	....	....	....	....	....	....	....	....	....
SUBTOTALS	11.2	22.4	33.5	44.5	44.5	44.5	44.5	44.5	44.5	33.4	22.3	11.1

FIGURE 4-6 CONTINUED

RESOURCE SCHEDULE

PROJECT NO. [illegible] non compat baseline

PAGE 1

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
A PLAN/ANALYSIS												
STAFF COST	61.4	106.3										
MACH COST	8.3	8.3										
B INVENT/STUDY												
MISC COST	22.5	22.5	22.5									
C WP IDENT/PREP												
STAFF COST		5.0	9.3	4.5	1.8							
MACH COST		0.6	0.6	0.6	0.6							
D TD GENR/VALID												
STAFF COST		11.9	18.7	9.0	3.7							
MACH COST		1.1	1.1	1.1	1.1							
E SOFTWARE CONV												
STAFF COST			145.7	215.7	222.8	228.4	214.3	206.7	213.4	122.6		
MACH COST			19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6		
F DF/DB CONV												
STAFF COST			9.1	13.2	13.3	13.4	12.6	12.2	12.6	7.2		
MACH COST			1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		
G OCL CONV												
STAFF COST				0.6	1.4	1.2	1.2	1.2	1.1	0.6		
MACH COST				0.1	0.1	0.1	0.1	0.1	0.1	0.1		
H REDOCUMENT												
STAFF COST							14.9	23.0	15.9	18.5	28.5	
I SYSTEM TEST												
STAFF COST										33.4	81.8	
MACH COST										5.8	5.8	
J ACCEPT TEST												
STAFF COST											11.2	60.8
MACH COST											3.6	3.6
K SITE PREP												
MISC COST	136.7	136.7	136.7									
L SYSTEM TRANS												
MISC COST				8.3	8.3	8.3	8.3	8.3	8.3	8.3		
M CONV TRAINING												
MISC COST												5032.0
N MAINT/CONT SPT												
STAFF COST	6.0	12.0	18.0	24.0	24.0	24.0	24.0	24.0	24.0	18.0	12.0	6.0
O TOOLS/AIDS												
SUBTOTALS												
STAFF COST	67.4	134.1	200.8	267.0	267.0	267.0	267.0	267.0	267.0	200.3	133.5	66.8
MACH COST	8.3	9.9	22.4	22.5	22.5	20.9	20.9	20.9	20.9	26.6	9.4	3.6
MISC COST	159.2	159.2	159.2	8.3	8.3	8.3	8.3	8.3	8.3	8.3		5032.0
TOTAL MONTH	234.9	303.2	382.5	297.9	297.9	296.2	296.2	296.2	296.2	235.2	142.9	5102.4

FILE: b:diffbase.SCH

FIGURE 4-6 CONTINUED

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                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ------->m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) --------> d

ENTER DESIRED PROJECT DURATION (EACH UNIT=1 MONTH) -------> 30

  STAFFING LEVEL WILL BE  14.8  PER MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? -------> n
```

FIGURE 4-7

TASK SCHEDULE
PROJECT NO. ems non compat baseline
(EACH COLUMN = 1 MONTH)

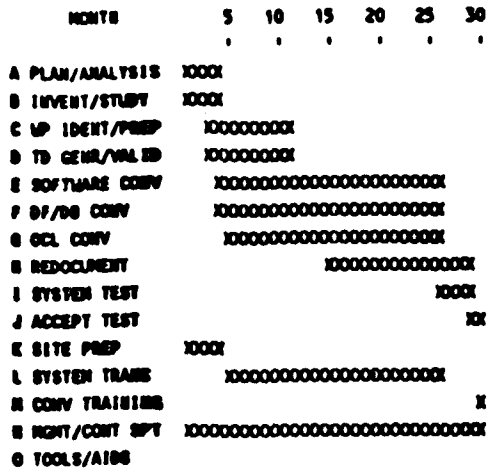


FIGURE 4-7 CONTINUED

STAFFING SCHEDULE
PROJECT NO. mms rsm compat baseline

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
A PLAN/ANALYSIS	3.4	6.7	9.8	7.7								
B INVENT/STUDY												
C MP IDENT/PREP			0.1	0.9	0.3	0.4	0.4	0.4	0.4	0.4	0.3	
D TD GENR/VALID			0.2	1.9	0.5	0.8	0.8	0.8	0.8	0.8	0.6	
E SOFTWARE CONV				2.8	11.9	11.6	11.6	11.6	11.7	11.7	11.9	12.9
F DF/DB CONV				0.2	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7
G OCL CONV												
H REDOCUMENT												
I SYSTEM TEST												
J ACCEPT TEST												
K SITE PREP												
L SYSTEM TRANS												
M CONV TRAINING												
N MGMT/CONT SPT	0.4	0.8	1.1	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3
O TOOLS/AIDS												
SUBTOTALS	3.8	7.5	11.2	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9

MONTH	13	14	15	16	17	18	19	20	21	22	23	24
A PLAN/ANALYSIS												
B INVENT/STUDY												
C MP IDENT/PREP												
D TD GENR/VALID												
E SOFTWARE CONV	12.8	12.8	12.4	11.4	11.6	11.6	11.6	11.6	11.6	11.5	11.5	11.6
F DF/DB CONV	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
G OCL CONV			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
H REDOCUMENT			0.3	1.4	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1
I SYSTEM TEST												
J ACCEPT TEST												
K SITE PREP												
L SYSTEM TRANS												
M CONV TRAINING												
N MGMT/CONT SPT	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
O TOOLS/AIDS												
SUBTOTALS	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8

FIGURE 4-7 CONTINUED

STAFFING SCHEDULE
PROJECT NO. ams ram compat baseline

MONTH	25	26	27	28	29	30
A PLAN/ANALYSIS						
B INVENT/STUDY						
C UP IDENT/PREP						
D TO GENR/VALID						
E SOFTWARE CONV	11.7	10.5				
F DF/DG CONV	0.7	0.6				
G OCL CONV	0.1	0.1				
H REDOCUMENT	1.1	0.9	2.6	1.0	0.3	
I SYSTEM TEST		1.4	10.9	5.3	1.6	
J ACCEPT TEST					4.8	7.2
K SITE PREP						
L SYSTEM TRANS						
M CONV TRAINING						
N MGMT/CONT SPT	1.3	1.3	1.3	1.0	0.7	0.3
O TOOLS/AIDS						
SUBTOTALS	14.8	14.8	14.8	7.3	7.4	7.5

FIGURE 4-7 CONTINUED

RESOURCE SCHEDULE

PROJECT NO. xxx non compat baseline

PAGE 1

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
A PLAN/ANALYSIS												
STAFF COST	28.4	40.2	58.6	46.4								
MACH COST	4.2	4.2	4.2	4.2								
B INVENT/STUDY												
MISC COST	16.9	16.9	16.9	16.9								
C MP IDENT/PREP												
STAFF COST			0.7	5.6	1.5	2.4	2.4	2.4	2.4	2.4	1.9	
MACH COST			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
D TD GENR/VALID												
STAFF COST			1.3	11.2	3.0	4.7	4.8	4.8	4.8	4.8	3.8	
MACH COST			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
E SOFTWARE CONV												
STAFF COST				16.6	71.6	69.3	69.6	69.7	70.3	70.3	71.7	77.3
MACH COST				6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
F DF/DB CONV												
STAFF COST				1.1	4.9	4.6	4.2	4.2	4.2	4.2	4.2	4.3
MACH COST				0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
G OCL CONV												
STAFF COST												
MACH COST					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H REDOCUMENT												
STAFF COST												
I SYSTEM TEST												
STAFF COST												
MACH COST												
J ACCEPT TEST												
STAFF COST												
MACH COST												
K SITE PREP												
MISC COST	102.6	102.6	102.6	102.6								
L SYSTEM TRANS												
MISC COST					2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
M CONV TRAINING												
MISC COST												
N MAINT/CONT SPT												
STAFF COST	2.4	4.8	6.6	8.4	8.4	8.4	8.4	8.4	7.8	7.8	7.8	7.8
O TOOLS/AIDS												
---	---	---	---	---	---	---	---	---	---	---	---	---
SUBTOTALS												
STAFF COST	22.8	45.0	67.2	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4
MACH COST	4.2	4.2	4.9	12.1	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.3
MISC COST	119.4	119.4	119.4	119.4	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
TOTAL MONTH	146.4	168.6	191.5	220.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.3

FIGURE 4-7 CONTINUED

RESOURCE SCHEDULE

PROJECT NO. ams non compet baseline

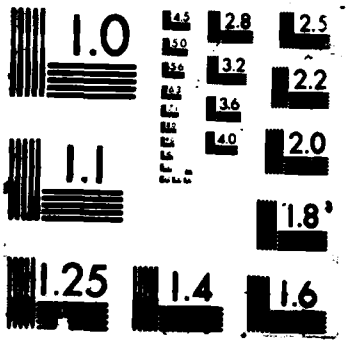
PAGE 2

MONTH	13	14	15	16	17	18	19	20	21	22	23	24
A PLAN/ANALYSIS												
STAFF COST												
MACH COST												
B INVENT/STUDY												
MISC COST												
C WP IDENT/PREP												
STAFF COST												
MACH COST												
D TD GENR/VALID												
STAFF COST												
MACH COST												
E SOFTWARE CONV												
STAFF COST	76.5	76.5	74.3	68.2	69.3	69.3	69.3	69.3	69.3	69.3	69.1	69.4
MACH COST	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
F DF/DB CONV												
STAFF COST	4.5	4.5	4.4	4.0	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.1
MACH COST	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	[illegible]
G OCL CONV												
STAFF COST			0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0
MACH COST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H REDOCUMENT												
STAFF COST			1.7	8.1	7.0	7.0	7.0	7.0	7.0	7.0	7.1	6.8
I SYSTEM TEST												
STAFF COST												
MACH COST												
J ACCEPT TEST												
STAFF COST												
MACH COST												
K SITE PREP												
MISC COST												
L SYSTEM TRANS												
MISC COST	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
M CONV TRAINING												
MISC COST												
N MGMT/CONT SPT												
STAFF COST	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
O TOOLS/AIDS												
---	---	---	---	---	---	---	---	---				
SUBTOTALS												
STAFF COST	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8
MACH COST	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
MISC COST	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
TOTAL MONTH	98.7	98.7	98.7	98.7	98.7	98.7	98.7	98.7	98.7	98.7	98.7	98

FIGURE 4-7 CONTINUED

AD-A186 247 SOFTWARE CONVERSION STUDY FOR THE MAINTENANCE PROCESSING SUBSYSTEM HARDWARE UPGRADE(U) COMPUTER TECHNOLOGY ASSOCIATES INC ENGLEWOOD CO JUN 87 2/2

UNCLASSIFIED DOT/FAA/CT-87/29 DTFA03-86-C-00018 F/G 12/5 NL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1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3

RESOURCE SCHEDULE
PROJECT NO. ams non compat baseline
PAGE 3

MONTH	25	26	27	28	29	30
A PLAN/ANALYSIS						
STAFF COST						
MACH COST						
B INVENT/STUDY						
MISC COST						
C WP IDENT/PREP						
STAFF COST						
MACH COST						
D TD GENR/VALID						
STAFF COST						
MACH COST						
E SOFTWARE CONV						
STAFF COST	70.1	63.0				
MACH COST	6.8	6.8				
F DF/DB CONV						
STAFF COST	4.0	3.7				
MACH COST	0.4	0.4				
G OCL CONV						
STAFF COST	0.6	0.6				
MACH COST	0.0	0.0				
H REDOCUMENT						
STAFF COST	6.3	5.3	15.6	6.0	1.8	
I SYSTEM TEST						
STAFF COST		8.4	65.4	31.8	9.6	
MACH COST		2.9	2.9	2.9	2.9	
J ACCEPT TEST						
STAFF COST					28.8	43.2
MACH COST					3.6	3.6
K SITE PREP						
MISC COST						
L SYSTEM TRANS						
MISC COST	2.6	2.6				
M CONV TRAINING						
MISC COST						5032.0
N MAINT/CONT SPT						
STAFF COST	7.8	7.8	7.8	6.0	4.2	1.8
O TOOLS/AIDS						
---	---	---	---	---	---	---
SUBTOTALS						
STAFF COST	88.8	88.8	88.8	43.8	44.4	45.0
MACH COST	7.3	10.1	2.9	2.9	6.5	3.6
MISC COST	2.6	2.6				5032.0
TOTAL MONTH	98.7	101.6	91.7	46.7	50.9	5080.6

FILE: b:diffbase.SCH

FIGURE 4-7 CONTINUED

```
                ESTABLISH SCHEDULING PARAMETERS AND BOUNDRIES

TOTAL LABOR ESTIMATE IS  33.4 Y.

WHAT IS DESIRED UNIT OF MEASURE FOR SCHEDULING?
  (Y=YEARS, Q=QUARTERS, M=MONTHS) ======>m

WOULD YOU LIKE INITIAL SCHEDULE TO BE BASED ON STAFFING LEVEL (S)
  OR PROJECT DURATION (D) =======> s

WHAT IS DESIRED STAFFING LEVEL? ======> 30

  APPROXIMATE DURATION WILL BE  17  MONTH.

  DO YOU WISH TO CHANGE THESE INITIAL PARAMETERS? ======> n
```

FIGURE 4-8

TASK SCHEDULE
PROJECT NO. ems ram compat baseline
(EACH COLUMN = 1 MONTH)

```
     MONTH          5   10   15   20
                    '   '    '    '
A PLAN/ANALYSIS   XXX
B INVENT/STUDY    XXX
C VP IDENT/PREP    XXXXXX
D TD GENR/VALID    XXXXXX
E SOFTWARE CONV     XXXXXXXXXXXXX
F DF/DB CONV        XXXXXXXXXXXX
G OCL CONV          XXXXXXXXXXXX
H REDOCUMENT              XXXXXXXX
I SYSTEM TEST                 XX
J ACCEPT TEST                  XX
K SITE PREP       XXX
L SYSTEM TRANS      XXXXXXXXXXX
M CONV TRAINING                X
N MAINT/CONT SPT  XXXXXXXXXXXXXXXX
O TOOLS/AIDS
```

FIGURE 4-8 CONTINUED

STAFFING SCHEDULE
PROJECT NO. mmm non compat baseline

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
A PLAN/ANALYSIS	5.7	12.1	9.8									
B INVENT/STUDY												
C UP IDENT/PREP		0.2	1.4	0.4	0.6	0.6	0.5					
D TO GENR/VALID		0.3	2.8	0.7	1.2	1.2	1.0					
E SOFTWARE CONV			5.0	23.5	22.9	23.1	23.3	24.7	24.3	22.6	22.6	22.6
F DF/DB CONV			0.3	1.5	1.4	1.4	1.4	1.5	1.4	1.3	1.3	1.3
G DCL CONV			0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
H REDOCUMENT									0.5	2.2	2.3	2.3
I SYSTEM TEST												
J ACCEPT TEST												
K SITE PREP												
L SYSTEM TRANS												
M CONV TRAINING												
N MAINT/CONT SPT	0.6	1.2	1.9	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
O TOOLS/AIDS												
SUBTOTALS	6.3	13.8	21.3	28.8	28.8	28.9	28.9	28.9	28.9	28.9	28.9	28.9

MONTH	13	14	15	16	17
A PLAN/ANALYSIS					
B INVENT/STUDY					
C UP IDENT/PREP					
D TO GENR/VALID					
E SOFTWARE CONV	22.8	23.6	0.5		
F DF/DB CONV	1.3	1.4			
G DCL CONV	0.1	0.1			
H REDOCUMENT	2.1	1.2	4.9	1.3	
I SYSTEM TEST			14.1	5.1	
J ACCEPT TEST				6.3	5.7
K SITE PREP					
L SYSTEM TRANS					
M CONV TRAINING					
N MAINT/CONT SPT	2.6	2.6	1.9	1.2	0.6
O TOOLS/AIDS					
SUBTOTALS	28.9	29.0	21.4	13.9	6.3

FIGURE 4-8 CONTINUED

RESOURCE SCHEDULE
PROJECT NO. mms non compat baseline
PAGE 1

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
A PLAN/ANALYSIS												
STAFF COST	34.2	72.6	58.8									
MACH COST	5.5	5.5	5.5									
B INVENT/STUDY												
MISC COST	22.5	22.5	22.5									
C MP IDENT/PREP												
STAFF COST		1.0	8.4	2.2	3.6	3.6	2.8					
MACH COST		0.4	0.4	0.4	0.4	0.4	0.4					
D TD GENR/VALID												
STAFF COST		2.0	16.8	4.4	7.1	6.9	6.0					
MACH COST		0.7	0.7	0.7	0.7	0.7	0.7					
E SOFTWARE CONV												
STAFF COST			30.3	140.8	137.4	138.5	140.1	148.4	145.7	135.8	135.6	135.6
MACH COST			12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
F DF/DB CONV												
STAFF COST			1.9	8.9	8.5	8.2	8.2	8.8	8.7	7.9	8.0	8.0
MACH COST			0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
G OCL CONV												
STAFF COST			0.3	0.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
MACH COST			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
H REDOCUMENT												
STAFF COST									2.8	13.5	13.7	13.7
I SYSTEM TEST												
STAFF COST												
MACH COST												
J ACCEPT TEST												
STAFF COST												
MACH COST												
K SITE PREP												
MISC COST	136.7	136.7	136.7									
L SYSTEM TRANS												
MISC COST				5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
M CONV TRAINING												
MISC COST												
N MAINT/CONT SPT												
STAFF COST	3.6	7.2	11.4	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
O TOOLS/AIDS												
---	---	---	---	---	---	---	---	---	---	---	---	---
SUBTOTALS												
STAFF COST	37.8	82.8	127.8	172.8	172.8	173.4	173.4	173.4	173.4	173.4	173.4	173.4
MACH COST	5.5	6.6	19.5	14.0	14.0	14.0	14.0	12.9	12.9	12.9	12.9	12.9
MISC COST	159.2	159.2	159.2	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
TOTAL MONTH	202.5	248.6	306.5	192.1	192.1	192.7	192.7	191.6	191.6	191.6	191.6	191.6

FIGURE 4-8 CONTINUED

RESOURCE SCHEDULE
PROJECT NO. mms non compat baseline
PAGE 2

MONTH	13	14	15	16	17
A PLAN/ANALYSIS					
STAFF COST					
MACH COST					
B INVENT/STUDY					
MISC COST					
C WP IDENT/PREP					
STAFF COST					
MACH COST					
D TD GENR/VALID					
STAFF COST					
MACH COST					
E SOFTWARE CONV					
STAFF COST	136.8	141.7	2.9		
MACH COST	12.1	12.1	12.1		
F DF/DB CONV					
STAFF COST	8.0	8.5			
MACH COST	0.8	0.8			
G OCL CONV					
STAFF COST	0.6	0.6			
MACH COST	0.1	0.1			
H REDOCUMENT					
STAFF COST	12.3	7.3	29.7	7.9	
I SYSTEM TEST					
STAFF COST			84.4	30.8	
MACH COST			5.8	5.8	
J ACCEPT TEST					
STAFF COST				37.5	34.5
MACH COST				3.6	3.6
K SITE PREP					
MISC COST					
L SYSTEM TRANS					
MISC COST	5.3	5.3			
M CONV TRAINING					
MISC COST					5032.0
N MGMT/CONT SPT					
STAFF COST	15.6	15.6	11.4	7.2	3.6
O TOOLS/AIDS					
---	---	---	---	---	---
SUBTOTALS					
STAFF COST	173.4	173.7	128.4	83.4	38.1
MACH COST	12.9	12.9	17.8	9.4	3.6
MISC COST	5.3	5.3			5032.0
TOTAL MONTH	191.6	191.9	146.2	92.7	5073.7

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FIGURE 4-8 CONTINUED

5. SUMMARY OF FINDINGS

5.1 ANALYSIS OF ALTERNATIVES

The following subsections discuss the results of the conversion study for the conversion of MMS software. It presents the benefits and risks for the compatible and non-compatible conversion alternatives analyzed in this study.

5.1.1 Fully Compatible Alternative

The compatible procurement alternative is based on the FAA having a limited competitive procurement to upgrade the current Tandem NS II processors and peripheral equipment at each of the 38 MPS Sites to a target environment of Tandem TXPs with greater capacity disks. This target environment is fully compatible with the current source environment (Tandem NS IIs).

5.1.1.1 Benefits

The benefits in pursuing a fully compatible target system are:

- The current MMS software will run on the target system without change;
- The total cost to migrate to the compatible hardware environment is $294,700 with $67,400 included for this study;
- There is zero schedule slippage in fielding MMS. The MMS software can be transferred to the target system immediately without any modifications required;
- The existing Tandem MPS network has been proven and is reliable;
- The FAA has invested a great deal of personnel time and money (in excess of $5.0 million) in Tandem training;
- The FAA has established maintenance procedures for the existing equipment which would have to established for a non-compatible target system;
- Tandem offers a fault-tolerant environment which provides checkpointing for transactions in MMS. This capability would have to be developed if it wasn't provided in the non-compatible target system;
- The MMS users will not experience any downtime; and
- There would be minimal hardware, and no software,

5.1.1.2 Risks

Because the compatible alternative would not be a fully competitive procurement the risks associated with this procurement are:

- The possibility of higher equipment costs; and
- Potentially not having the best ADP solution.

5.1.2 Non-compatible Alternative

This alternative is based on the FAA holding a fully competitive procurement that will result in the acquisition of replacement ADP hardware for the MPS sites that is non-compatible with the current Tandem equipment. This conversion alternative assumes that a state-of-the-art environment will be implemented.

5.1.2.1 Benefits

The benefits from this alternative are derived from the competitive nature of the procurement. The benefits are:

- Possible lower hardware costs; and
- Possible innovative ADP solution.

5.1.2.2 Risks

The risks associated with a non-compatible target environment are:

- The current MMS software would require major changes and extensive rewrite due to dependencies on specific features of the Tandem environment;
- The estimated cost to convert the MMS software to a non-compatible environment is high ($8,181,600);
- The delay in fielding MMS software to the user community would be extensive (in the MPS Hardware Upgrade Trade Study, dated October 21, 1986, the conversion of MMS was estimated to take 30 months). This was calculated using the COCOMO Model (Constructive Cost Model) developed by Barry Boehm and described in detail in his book, "Software Engineering Economics" (Prentice-Hall, 1981). This represents an optimum conversion schedule for MMS as calculated by Boehm's scheduling algorithm. Using the 30 month duration as input into FSMC's Conversion Cost Model yields an average staffing level requirement of 14.8 staff members per month;

- A four month conversion duration requires an average staffing level of 133.6 staff members per month (from the Conversion Cost MOdel);

- A six month conversion duration requires an average staffing level of 83.5 staff members per month (from the Conversion Cost Model);

- An eight month conversion duration requires an average staffing level of 66.8 staff members per month (from the Conversion Cost Model);

- A twelve month conversion duration requires an average staffing level of 44.5 staff members per month (from the Conversion Cost Model);

- If an average staff level of 30 is used as input then the conversion duration is estimated to be seventeen months by the Conversion Cost Model;

- There is a real possibility for conversion cost overruns and schedule slippages with this approach;

- The use of checkpointing, provided in Tandem's PATHWAY applications development environment, would have to be provided in the target system or be developed. This would add significant costs and time delays to the conversion process;

- The original Tandem training investment would be lost and an additional training cost of $5,032,000 would be required; and

- The investment in the current maintenance operations for the MPS sites would have to be redone.

5.2 FUTURE CONVERSION

The FAA will incorporate the following actions in order to minimize the costs and risks of any future conversions:

- Use only standard high-level programming languages;

- Use of ANSI standard code and no vendor extensions to the code;

- Where feasible, use DBMS packages that are not machine dependent;

- Use off-the-shelf automated tools to support program development, software enhancements, requirements analysis, maintenance and management;

- Document system and applications thoroughly and keep the documentation up-to-date;

- Identify and document thoroughly all interfaces and interdependencies of software, hardware, data bases, telecommunications, and operations to allow coordinated systems integration efforts; and

- Adhere to military and industry accepted standards for software development in order to improve the portability and the maintainability of the software.

6. PROCUREMENT AND IMPLEMENTATION SCHEDULE

6.1 MPS HARDWARE UPDATE PLAN

Procurement and installation schedules have been developed which give FAA management milestones to use in planning its procurement and implementation activities. Figure 6-1 reflects the procurement schedule and Figure 6-2 the installation schedule as planned by the FAA as of May 1987.

FIGURE 6-1

MPS HARDWARE UPGRADE PROCUREMENT SCHEDULE

ACTIVITY/MILESTONE	TARGET DATE
Procurement Request Released	09/29/87
Solicitation Released	11/30/87
Contract Award	02/12/88
System Delivered to 1st Operational Site	03/15/88
1st Operational Readiness Demonstration (ORD) Completed	04/06/88
System Delivered to Last Operational Site	12/07/88
Last ORD Completed	12/30/88

FIGURE 6-2

MPS SITES and INSTALLATION SCHEDULE

Item	Description	Installation Schedule (Weeks After Contract Award)	Site
0001	MPS SITE # 1	11	Kansas City ARTCC (ZKC) FAA Airway Facilities Sector 1801 East Loula Street Olathe, KS 66062
0002	MPS SITE # 2	11	Los Angeles ARTCC (ZLA) FAA Airway Facilities Sector 22255 E. Avenue Palmdale, CA 93550
0003	MPS SITE # 3	15	Anchorage ARTCC (ZAN) FAA AFS, Elmendorf AFB 5400 Davis Highway Anchorage, AK 99506
0004	MPS SITE # 4	18	Chicago ARTCC (ZAU) FAA Airway Facilities Sector 619 Indian Trail Road Aurora, IL 60507
0005	MPS SITE # 5	14	Atlanta ARTCC (ZTL) FAA Airway Facilities Sector 199 Woolsey Road Hampton, GA 30228
0006	MPS SITE # 6	12	Ft. Worth ARTCC (ZFW) FAA Airway Facilities Sector 13800 FAA Road Euless, TX 76039
0007	MPS SITE # 7	16	San Juan ARTCC (ZSU) FAA AFS Loiza Expressway, FAA Bldg. San Juan, PR 00914
0008	MPS SITE # 8	13	Houston ARTCC (ZHU) FAA Airway Facilities Sector P.O. Box 30608 16608 John F. Kennedy Blvd. Houston, TX 77205

Item	Description	Installation Schedule (Weeks After Contract Award)	Site
0009	MPS SITE # 9	17	Jacksonville ARTCC (ZJX) FAA Airway Facilities Sector 811 East Second Street Hilliard, FL 32046
0010	MPS SITE # 10	15	Albuquerque ARTCC (ZAB) FAA Airway Facilities Sector 6900 Los Angeles Drive, N.E. Albuquerque, NM 87113
0011	MPS SITE # 11	17	Miami ARTCC (ZMA) FAA Airway Facilities Sector 7500 NW 58th Street Miami, FL 38118
0012	MPS SITE # 12	18	Oakland ARTCC (ZOA) FAA Airway Facilities Sector 5125 Central Avenue Fremont, CA 94536
0013	MPS SITE # 13	9/10	Memphis ARTCC (ZME) FAA Airway Facilities Sector 3229 Democrat Road Memphis, TN 38118
0014	MPS SITE # 14	13	Seattle ARTCC (ZSE) FAA Airway Facilities Sector 1077 Pacific Highway Seattle, WA 98168
0015	MPS SITE # 15	17	Honolulu ARTCC (ZHN) FAA Airway Facilities Sector 4-204 Diamond Head Road Honolulu, HI 96816
0016	MPS SITE # 16	17	Salt Lake City ARTCC (ZLC) FAA Airway Facilities Sector 2150 West 700 North Salt Lake City, UT 84116
0017	MPS SITE # 17	14	Denver ARTCC (ZDV) FAA Airway Facilities Sector 2211 17th Avenue Longmont, CO 80501
0018	MPS SITE # 18	15	Minneapolis ARTCC (ZMP) FAA Airway Facilities Sector 7500 Division Street Farmington, MN 55024

Item	Description	Installation Schedule (Weeks After Contract Award)	Site
0019	MPS SITE # 19	16	Indianapolis ARTCC (ZID) FAA Airway Facilities Sector 200 Bauman Avenue Indianapolis, IN 46241
0020	MPS SITE # 20	16	Cleveland ARTCC (ZOB) FAA Airway Facilities Sector 326 East Lorain Street Oberlin, OH 44074
0021	MPS SITE # 21	16	Washington ARTCC (ZDC) FAA Airway Facilities Sector Intersec. Rt. 7 and 654 Leesburg, VA 22075
0022	MPS SITE # 22	14	New York ARTCC (ZNY) FAA Airway Facilities Sector 4205 Johnson Avenue Ronkonkoma, NY 11779
0023	MPS SITE # 23	14	Boston ARTCC (ZBN) FAA Airway Facilities Sector 35 Northeastern Boulevard Nashua, NH 03062
0024	MPS SITE # 24	7/8	FAA Headquarters (AES-420) FOB 10A, 6th Floor 800 Independence Ave, S.W. Washington, D.C. 20591
0025	MPS SITE # 25	5/6	FAA Technical Center, ACT-110 Atlantic City Airport Atlantic City, NJ 08405
0026	MPS SITE # 26	18	FAA Technical Center FAA APM-160 Atlantic City Airport Atlantic City, NJ 08405
0027	MPS SITE # 27	18	FAA Academy, AAC-940 Mike Monroney Aeronautical Ctr 6500 S. MacArthur Ave. Oklahoma City, OK 73125
0028	MPS SITE # 28	20	Mike Monroney Aeronautical Ctr FAA APM-150 6500 S. MacArthur Ave. Oklahoma City, OK 73125

Item	Description	Installation Schedule (Weeks After Contract Award)	Site
0029	MPS SITE # 29	12	Dallas/Ft. Worth AFS (DFW) DFW Arpt., Parkway Plaza, RM 801 P.O. Box 61368 Dallas/Ft. Worth, TX 75261
0030	MPS SITE # 30	9/10	Memphis AFS (MEM) P.O. Box 30050 2515 Winchester Road Memphis, TN 38130
0031	MPS SITE # 31	19	Norfolk AFS (ORF) DOT FAA AFS 842 2740 Ellesmere Ave. Norfolk, VA 23513
0032	MPS SITE # 32	19	Windsor Locks AFS (BDL) Bradley International Airport Air Kaman Building, 2nd Floor Windsor Locks, CN 06096
0033	MPS SITE # 33	19	Detroit AFS (DET) Willow Run Airport East, 8800 Beck Road Belleville, MI 48111
0034	MPS SITE # 34	20	St. Louis AFS (STL) Lambert Field 3751 Penridge Sqr., Suite 112 Bridgeton, MO 63044
0035	MPS SITE # 35	20	Wichita AFS (ICT) Mid Continent Airport Terminal Building, Rm 200 Wichita, KN 67209
0036	MPS SITE # 36	19	Denver AFS (DEN) FAA Airway Facilities Sector 10455 East 25th Ave, Rm 304 Aurora, CO 80010
0037	MPS SITE # 37	20	Lancaster AFS (WJF) FAA Airway Facilities Sector 660 West Avenue "J" Lancaster, CA 93534
0038	MPS SITE # 38	15	Fairbanks AFS (FAI) FAA AFS, Elmendorf AFB 5400 Davis Highway Anchorage, AK 99506

7. FSMC INVENTORY FORMS

This Section contains the completed worksheets specified by the Federal Software Management Support Center (FSMC) to describe selected inventory information input to the Cost Conversion Model. FSMC worksheets for the report are contained within the specific sections of the report which initially reference them. The model input Form Numbers, Information Description, and page numbers are provided below.

FMSC MODEL INPUTS

FORM 23. TESTING INFORMATION

System(s)	*Percent of Existing Test Data	*Percent of Required Test Data	Number of Days Duration for Acceptance Testing	Remarks
Logging	74%	80%	Effort = 288 staff days Duration = 60 days	
Periodic Maintenance /Certification & Scheduling	74%	70%	Effort = 48 staff days Duration = 48 days	
Report Generation	74%	70%	Effort = 48 staff days Duration = 48 days	
Facility, Service and Equipment Profile	74%	70%	Effort = 48 staff days Duration = 48 days	
Administration	74%	70%	Effort = 48 staff days Duration = 48 days	
Help	74%	70%	Effort = 48 staff days Duration = 48 days	
Security	74%	100%	Effort = 48 staff days Duration = 48 days	
Total:	74%	77.5%	108	

* The percent of existing test data refers to the percentage of code the existing data set exercises

* The percent of required test data refers to the percentage of code that the test data will be required to exercise before the system is accepted.

FORM 24. DOCUMENTATION STATUS

Document	Complete	Incomplete	Not Applicable	Remarks
Functional Description		X		Level A Specification
Data Requirements Document		X		Level B Specification
System/ Subsystem Spec	X			MMS System Design Document
Program Specification		X		MMS System Design Document
Database Specification		X		MMS System Design Document
Users Manual	X			
Computer Operations Manual		X		
Program Maintenance Manual		X		No Documentation Available
System Flow Chart		X		MMS System Design Document
Test Data Printouts		X		
Program Listings	X			
User Instructions		X		Training Manual
Other (File Record Layouts)	X			MMS System Design Document
Other (Program Flowchart)		X		None Available

FORM 29. SOFTWARE SUMMARY

CONVERSION ALTERNATIVE: Non-Compatible

SYSTEM ID: MMS SOFTWARE TYPE: Application

DATE: 4/25/87

LANGUAGE	CONVERSION CLASS	NO. OF PROGRAMS	LINES OF CODE	TRANSLATION %
SCOBOL	1	328	214,659	0
COBOL-74 (CLASS-2)	2	108	28,520	0
COBOL-74 (CLASS-5)	5		71,732	Not Required
TAL	1	(NA)	1,392	0
DDL	1	(NA)	19,567	0
TOTALS	N/A	436	335,870	N/A

FORM 30. OPERATION CONTROL LANGUAGE SUMMARY FORM

CONVERSION ALTERNATIVE: Non-Compatible

SYSTEM ID: MMS

DATE: 4/25/87

LANGUAGE	CONVERSION CLASS	NO. OF JOB STREAMS	LINES OF CODE	TRANSLATION %
PATHCOM* PATHMON	1	80	1,585**	0
TOTALS				

* Includes PATHWAY Configuration

** Includes Command Files to Execute Reports

FORM 31. DATA FILE AND DATABASE SUMMARY

CONVERSION ALTERNATIVE: Non-Compatible

SYSTEM ID: MMS

DATE: 4/25/87

NUMBER OF FILES	ACCESS METHOD	FIXED/ VARIABLE FORMAT	STORAGE MEDIA	CLASS	REMARKS
32*	ISAM	FIXED	DISK	A	Class A because all files are part of Tandems DBMS-ENCOMPASS
2*	SAM	FIXED	DISK	A	Same as above
2*	RAM	FIXED	DISK	A	Same as above
* All files are part of Tandem's Relational DBMS-ENCOMPASS					
TOTAL 36					

FORM 32. DOCUMENTATION RATING SUMMARY

SYSTEM ID: MMS PROGRAM ID: _____
DATE: 4/17/87 PREPARED BY: _____

DOCUMENT	VALUE (0-10)
Function Description	7
Data Requirements Document	3.5
System/Subsytem Specification	10
Program Specification	5
File/Data Base Specification	5
Users Manual	9.5
Computer Operations Manual	8
Program Maintenance Manual	0
System Flow Chart	5
Test Data Printouts	7
Program Listings	10
User Instructions	8
File Record Layouts	10
Other (Program Flowcharts)	0
Total (Not to exceed 100)	88

32. DOCUMENTATION RATING SUMMARY (Continued)

Documentation Value	Description of Documentation
10	Complete set exists and is up-to-date
9	Complete set, but somewhat out-of-date
8	Extensive amount exists, is incomplete but usable, and is up-to-date
7	Extensive amount exists, is incomplete but usable, and is out-of-date
6	Extensive amount exists, is incomplete but usable, and is out-of date
5	Moderate amount exists, is incomplete but usable, and is up-to-date
4	Moderate amount exists, is incomplete but usable, and is out-of-date
3	Moderate amount exists, is incomplete and not usable, and is out-of-date
2	Very little, if any, exists, and is out-of-date
1	Very little, if any, exists, and is out-of-date
0	No documentation exists, or unknown as to what exists, its usefulness, and its currency

8. ACRONYMS USED IN THIS DOCUMENT

AAT	Air Traffic
ADL	Development and Logistics
ADP	Automatic Data Processing
ADPE	ADP Equipment
AES	System Engineering Services
AF	Airway Facilities
ANSI	American National Standards Institute
APM	Program Engineering and Maintenance
ARTCC	Air Route Traffic Control Center
ASCII	American Standard Code for Information Interchange
COTR	Contracting Officer's Technical Representative
COBOL	Common Business Oriented Language
CPU	Central Processing Unit
DBA	Data Base Administrator
DBMS	Data Base Management System
DDL	Data Definition Language
DOC	Document percentage
DOT	Department of Transportation
DUR	Duration
EFSS	Engineering Field Support Sector
FAA	Federal Aviation Administration
FCSC	Former name for FSMC
FMF	Facilities Master File
FSEP	Facilities Services and Equipment Profile
FSMC	Federal Software Management Conversion Center
GNAS	General NAS
GSA	General Services Administration
HDR	Hardware Discrepancy Report
HQ	Headquarters
IMCS	Interim Monitor and Control Software
IOCS	Input Output Control Services Inc.
ISAM	Indexed Sequential Access Method
J	Jobstream
MAPO	Maintenance Automation Program Office (AMP-1)
MCS	Monitor and Control Software
MMS	Maintenance Management System
MPS	Maintenance Processing Subsystem
NAS	National Airspace System
NCP	NAS Change Proposal
NFIS	NAS Facilities Information System
NS	Non Stop
OCL	Operation Control Language
P	Program
PTR	Program Technical Report
RAM	Random Access Method
RCOR	Re-documentation Coordinator
RMS	Remote Monitoring System
RMMS	Remote Maintenance Monitoring System
RMSC	Remote Monitoring System Concentrators
S	System
SAM	Sequential Access Method
SCOBOL	Screen COBOL

SCUP	SCOBOL Utility Program
SD	Staff Day
SDC	Systems Development Corporation (now Unisys)
SE	Systems Engineer
SH	Staff Hour
SY	Staff Year
TAL	Tandem Application Language
TCP	Terminal Control Program
TDE	Existing Test Data
TDR	Test Data Required
TID	Technician in Depth
TMF	Transaction Monitoring Facility
XRAY	Tandem's name for its Performance Monitoring System

U.S. GOVERNMENT PRINTING OFFICE: 1987-704-075/60110

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1988